Ontario

Ministry of
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Geology of

Carbonatite – Alkalic Rock Complexes, Ontario:

Sturgeon Narrows and Squaw Lake Alkalic Rock Complexes

District of Thunder Bay

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AND MINES
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Ontario Geological Survey
Study 49

by R. P. Sage

1988

93-00840/

© 1988 Queen's Printer for Ontario
ISSN 0704-2590
Printed in Ontario, Canada
ISBN 0-7729-0584-3

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Canadian Cataloguing in Publication Data

Sage, R. P.

Geology of carbonatite-alkalic rock complexes in Ontario: Sturgeon Narrows and Squaw Lake alkalic rock complexes, district of Thunder Bay

(Ontario Geological Survey study, ISSN 0704-2590 ; 49)
Includes index.
ISBN 0-7729-0584-3

1. Carbonatites—Ontario—Sturgeon Narrows (Thunder Bay) 2. Carbonatites—Ontario—Squaw Lake (Thunder Bay) 3. Alkalic igneous rocks—Ontario—Sturgeon Narrows (Thunder Bay) 4. Alkalic igneous rocks—Ontario—Squaw Lake (Thunder Bay) I. Ontario. Ministry of Northern Development and Mines. II. Ontario Geological Survey. III. Title. IV. Series.

QE461.S23 1988 552'.1'0971312 C88-099675-7

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Parts of this publication may be quoted if credit is given. It is recommended that reference to this report be made in the following form:

Sage, R.P.
1988: Geology of Carbonatite – Alkalic Rock Complexes in Ontario: Sturgeon Narrows and Squaw Lake Alkalic Rock Complexes, District of Thunder Bay; Ontario Geological Survey, Study 49, 117p.

1000-88-Lowe-Martin Co. Inc.

Foreword

The Sturgeon Narrows and Squaw Lake Alkalic Rock Complexes were examined as part of a project to study alkalic rock – carbonatite complexes in Ontario. The study describes the rock types and mineralogy of the complexes and outlines the history of the mineral exploration efforts within the complexes.

V.G. Milne

Director
Ontario Geological Survey

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CHART (back pocket)

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Conversion from SI to Imperial			Conversion from Imperial to SI		
SI Unit	*Multiplied by*	*Gives*	*Imperial Unit*	*Multiplied by*	*Gives*
		LENGTH			
1 mm	0.039 37	inches	1 inch	**25.4**	mm
1 cm	0.393 70	inches	1 inch	**2.54**	cm
1 m	3.280 84	feet	1 foot	**0.304 8**	m
1 m	0.049 709 7	chains	1 chain	20.116 8	m
1 km	0.621 371	miles (statute)	1 mile (statute)	**1.609 344**	km
		AREA			
1 cm^2	0.155 0	square inches	1 square inch	**6.451 6**	cm^2
1 m^2	10.763 9	square feet	1 square foot	**0.092 903 04**	m^2
1 km^2	0.386 10	square miles	1 square mile	2.589 988	km^2
1 ha	2.471 054	acres	1 acre	0.404 685 6	ha
		VOLUME			
1 cm^3	0.061 02	cubic inches	1 cubic inch	**16.387 064**	cm^3
1 m^3	35.314 7	cubic feet	1 cubic foot	0.028 316 85	m^3
1 m^3	1.308 0	cubic yards	1 cubic yard	0.764 555	m^3
		CAPACITY			
1 L	1.759 755	pints	1 pint	0.568 261	L
1 L	0.879 877	quarts	1 quart	1.136 522	L
1 L	0.219 969	gallons	1 gallon	**4.546 090**	L
		MASS			
1 g	0.035 273 96	ounces (avdp)	1 ounce (avdp)	28.349 523	g
1 g	0.032 150 75	ounces (troy)	1 ounce (troy)	**31.103 476 8**	g
1 kg	2.204 62	pounds (avdp)	1 pound (avdp)	**0.453 592 37**	kg
1 kg	0.001 102 3	tons (short)	1 ton (short)	**907.184 74**	kg
1 t	1.102 311	tons (short)	1 ton (short)	**0.907 184 74**	t
1 kg	0.000 984 21	tons (long)	1 ton (long)	**1016.046 908 8**	kg
1 t	0.984 206 5	tons (long)	1 ton (long)	**1.016 046 908 8**	t
		CONCENTRATION			
1 g/t	0.029 166 6	ounce (troy)/ ton (short)	1 ounce (troy)/ ton (short)	34.285 714 2	g/t
1 g/t	0.583 333 33	pennyweights/ ton (short)	1 pennyweight/ ton (short)	1.714 285 7	g/t

OTHER USEFUL CONVERSION FACTORS

1 ounce (troy) per ton (short)	20.0	pennyweights per ton (short)
1 pennyweight per ton (short)	0.05	ounces (troy) per ton (short)

Note: Conversion factors which are in bold type are exact. The conversion factors have been taken from or have been derived from factors given in the Metric Practice Guide for the Canadian Mining and Metallurgical Industries, published by the Mining Association of Canada in cooperation with the Coal Association of Canada.

Geology of

Carbonatite – Alkalic Rock Complexes in Ontario:

Sturgeon Narrows and Squaw Lake Alkalic Rock Complexes

District of Thunder Bay

R.P. Sage[1]

1. Geologist, Precambrian Geology Section, Ontario Geological Survey, Toronto. Manuscript approved for publication by John Wood, Chief Geologist, Ontario Geological Survey, December 21, 1983.

This report is published with the permission of V.G. Milne, Director, Ontario Geological Survey.

Abstract

The Sturgeon Narrows and Squaw Lake Alkalic Rock Complexes lie within the Wabigoon Subprovince of the Superior Province of the Canadian Shield. The plutons intrude a supracrustal assemblage of the Sturgeon Lake metavolcanic–metasedimentary belt. Both intrusions are likely of Early Precambrian age.

The Sturgeon Narrows Alkalic Rock Complex can be broadly subdivided into three rock groups: coarse–grained nepheline syenite and syenite, medium–grained leucocratic nepheline syenite, and syenodiorite. The syenodiorite is located principally within the northeast part of the complex. The coarse–grained nepheline syenite is commonly trachytoidal and encloses the medium–grained leucocratic nepheline syenite which occupies the core area of the complex. A regional shear zone occurs along the northwest flank of the Sturgeon Narrows Alkalic Rock Complex.

The Squaw Lake Alkalic Rock complex can be roughly subdivided into a northern portion where nepheline–bearing phases are present and a southern portion where quartz–bearing phases are found. The rock types are nepheline syenite, syenite, monzonite, syenomonzonite, and quartz monzonite. Xenolithic and hybrid phases occur along the contact area with the enveloping wall rocks. The Squaw Lake Alkalic Rock Complex has not been extensively deformed.

The Sturgeon Narrows Alkalic Rock Complex may contain some nepheline–rich rocks of potential economic interest. Neither the Sturgeon Narrows or Squaw Lake bodies appear to have the economic potential for rare earths, phosphorus, uranium, or base metals that can be found in younger alkalic rock complexes. The Sturgeon Narrows complex is more silica–undersaturated than the Squaw Lake complex and thus likely has greater potential for mineralization characteristic of the alkalic rock suite.

Rubidium–strontium isotopic determinations have suggested an age of 2400 $\pm$ 100 Ma years for the Sturgeon Narrows Alkalic Rock Complex. A Pb–Pb isotopic model age of 2686 $\pm$ 14 Ma has been obtained on the Sturgeon Narrows Alkalic Rock Complex. The older age is most likely a closer approximation of its true age.

Résumé

Les complexes rocheux alcalins du lac Squaw et Sturgeon Narrows sont situés dans la sous–province de Wabigoon, dans la province Supérieure du bouclier canadien. Les plutons font intrusion dans un assemblage supracrustal de la zone de roches volcaniques et sédimentaires métamorphisées du lac Sturgeon. Il semble que les deux intrusions datent du Précambrien inférieur.

Le complexe rocheux alcalin Sturgeon Narrows peut être divisé en trois groupes rocheux: la syénite et la syénite néphéline à gros grain, la syénite néphéline leucocrate à grain moyen et la monzonite. Cette dernière est principalement située dans la partie nord–est du complexe. La syénite néphéline à gros grain est généralement trachytoide et englobe la syénite néphéline leucocrate à grain moyen qui est située au coeur du complexe. Une zone cisaillée régionale est située sur le flanc du complexe rocheux alcalin Sturgeon Narrows.

Le complexe rocheux alcalin du lac Squaw peut être divisé en une partie nord où l'on trouve des phases contenant de la néphéline et une partie sud formée de phases contenant du quartz. Le complexe est composé de syénite néphéline, de syénite, de monzonite, de syénomonzonite et de monzonite de quartz. On remarque également la présence de phases xénolites et hybrides le long de la zone de contact avec les roches encaissantes. Le complexe rocheux alcalin du lac Squaw n'a pas été soumis à une déformation importante.

Le complexe rocheux alcalin Sturgeon Narrows pourrait contenir quelques roches riches en néphéline qui pourraient faire l'objet d'une exploitation commerciale. Aucun des deux complexes ne semblent être suffisamment riches en terres rares, en phosphore, en uranium et en métaux de base, comparativement aux complexes rocheux alcalins moins âgés, pour faire l'objet d'une exploitaion commerciale. Le complexe Sturgeon Narrows est plus sous–saturé en silice que celui du lac Squaw et, par conséquent, il est plus probable que sa minéralisation soit typique au cortège rocheux alcalin.

D'après les techniques isotopiques de datation au rubidium et au strontium, l'âge du complexe rocheux alcalin Sturgeon Narrows serait de 2400 $\pm$ 100 Ma. D'après un modèle isotopique au Pb–Pb, l'âge du complexe rocheux alcalin Sturgeon Narrows serait de 2686 $\pm$ 14 Ma. Ce résultat est sans doute plus exact.

Geology of Carbonatite – Alkalic Rock Complexes in Ontario: Sturgeon Narrows and Squaw Lake Alkalic Rock Complexes, District of Thunder Bay, by R.P. Sage. Ontario Geological Survey, Study 49, 117p. Published 1988. ISBN 0–7729–0584–3.

Introduction

The Squaw Lake and Sturgeon Narrows complexes are two of a number of Early Precambrian alkalic rock complexes within Ontario. These two complexes were chosen for study to provide a comparison of older alkalic rock complexes with younger, Late Precambrian alkalic rock complexes. The younger alkalic rock complexes are known to contain greater concentrations of elements of potential economic interest than the older intrusions.

The Sturgeon Narrows and Squaw Lake complexes intrude the supracrustal rocks of the Sturgeon Lake metavolcanic–metasedimentary belt. The supracrustal rocks have been metamorphosed to the greenschist facies rank of regional metamorphism. The lithologic trends of the supracrustal rocks generally wrap around the alkalic intrusions but local discordancies are present (Trowell 1974, Trowell 1976). An Early Precambrian age of 2400 ± 100 Ma was obtained using Rb–Sr isotopic techniques (Bell *et al.* 1979) and a Pb–Pb model age of 2686 ± 14 Ma was calculated by Kwon (1986). The Sturgeon Narrows complex consists of an outer zone of coarse–grained syenite and nepheline syenite which are locally trachytoidal, and an inner zone of finer–grained leucocratic nepheline syenite with local coarse–grained to pegmatitic phases. In the northeast corner of the Sturgeon Narrows complex is a body of medium–grained syenodiorite which locally displays poorly developed mafic banding. This unit contains pyroxene, amphibole and biotite in amounts generally greater than 30%. The Sturgeon Narrows complex has been subjected to post–emplacement metamorphic and tectonic events, particularly in proximity to Sturgeon Narrows. The deformation was locally sufficiently intense to form mylonite zones within the coarse–grained phases of the intrusion.

The Squaw Lake intrusion is much more poorly exposed than the Sturgeon Narrows complex. It consists of a series of rocks more silica–saturated than the Sturgeon Narrows complex. It varies in composition from nepheline syenite to monzonite with local areas containing sufficient quartz to be classified as quartz monzonite. The Squaw Lake intrusion has not undergone deformation as strong or as intensive as the Sturgeon Narrows complex.

In the case of the Sturgeon Narrows complex, control of its emplacement may have been provided by the axial plane of folding for the supracrustal rocks of the Sturgeon Lake metavolcanic belt. The structural control for the emplacement of Squaw Lake intrusion is not apparent.

Exploration for mineral deposits throughout the Sturgeon Lake area has been extensive and some of these efforts have covered portions of the Sturgeon Narrows and Squaw Lake intrusions. Mineralization of potential economic interest is not known to exist within either complex. The best potential for the location of mineral deposits of economic interest would appear to lie within the enclosing supracrustal wall rocks.

Acknowledgments

The descriptions of the supracrustal rocks have been largely condensed from Trowell (1976, 1983). The geological map (Figure 3, Chart A, back pocket) was compiled in part from Trowell (1972a,b, 1974).

Mr. W. Wright served as senior geological assistant and Mr. P. Chamois and Mr. C. Higgins, working as junior assistants, assisted Mr. Wright and the author

during mapping operations. Mr. Wright examined the Squaw Lake intrusion. The author and Mr. Wright worked jointly on the Sturgeon Narrows complex. W. Wright prepared the section on the Squaw Lake complex. In 1988, Mr. A. Lisowyk recalculated the statistics on the rock chemistry.

Mr. Art Mousseau, lodge owner on Sturgeon Lake, supplied the field party with a campsite, board, boats and motors for the duration of the project.

Location and Access

The Sturgeon Narrows Alkalic Rock Complex (Figure 1) is located on the east side of Sturgeon Lake and centered approximately at 50°00' N Latitude and 90°43' W Longitude. The complex is readily accessible by boat from any one of several boat landings on the west shore of Sturgeon Lake. Roads to the boat landings run east from Highway 599 south of the small community of Savant Lake.

The Squaw Lake Alkalic Rock Complex lies approximately 10 km northeast of the Sturgeon Narrows Alkalic Rock Complex and can be reached by portaging up Vista Creek from Sturgeon Lake. Boats on Squaw Lake can be rented from the local lodge owners. The complex is centred on Squaw Lake at approximately 50°03'45" N Latitude, 90°33' W Longitude.

Neither of the complexes is well exposed. The best exposures of the Sturgeon Narrows Alkalic Rock Complex are at its southern end, on islands in Sturgeon Lake located at the southern entrance to Sturgeon Narrows, at the northeast corner, and in the east–central portion of the complex. Outcrops of the Squaw Lake intrusion are confined principally to the shoreline of Squaw Lake.

Field Methods

Mapping was by pace and compass techniques using acetate overlays on 1:15 840 scale airphotos. Field data was then transferred from the acetate overlays to a base map at the same scale prepared from Preliminary Maps P.762 and P.968 by overlaying the maps with blank cronoflex and tracing the pertinent data. Previous outcrop data for areas not examined by the author or Mr. Wright were compiled from Trowell (1972a,b, 1974). The mapping for this project was of a reconnaissance nature.

Previous Geological Work

Miller (1903, p.104–105), Moore (1911, p.155), Gledhill (1925, p.33–38), Graham (1930, p.43–44), Rogers (1964, p.27–30), Trowell (1976, 1983) have all given descriptions of the Sturgeon Narrows complex. Gledhill (1925, p.36), Graham (1930, p.43) and Trowell (1983) have also described the Squaw Lake intrusion. Kwon (1986) completed isotopic studies of the Sturgeon Narrows complex.

Physiography

The topographic relief on the Sturgeon Narrows and Squaw Lake complexes is low and rolling. Some of the precipitous cliff faces found on Seaton Island are likely the result of faulting along Sturgeon Narrows. In general, the topographic relief does not exceed 15 m and abrupt precipitous cliffs are rare. Local areas of marshy ground are present and the area is heavily forested with mixed deciduous and coniferous trees.

Laboratory Techniques

The freshest and most homogeneous samples were selected for thin section study and complete rock analysis. All samples selected for rock analysis were trimmed

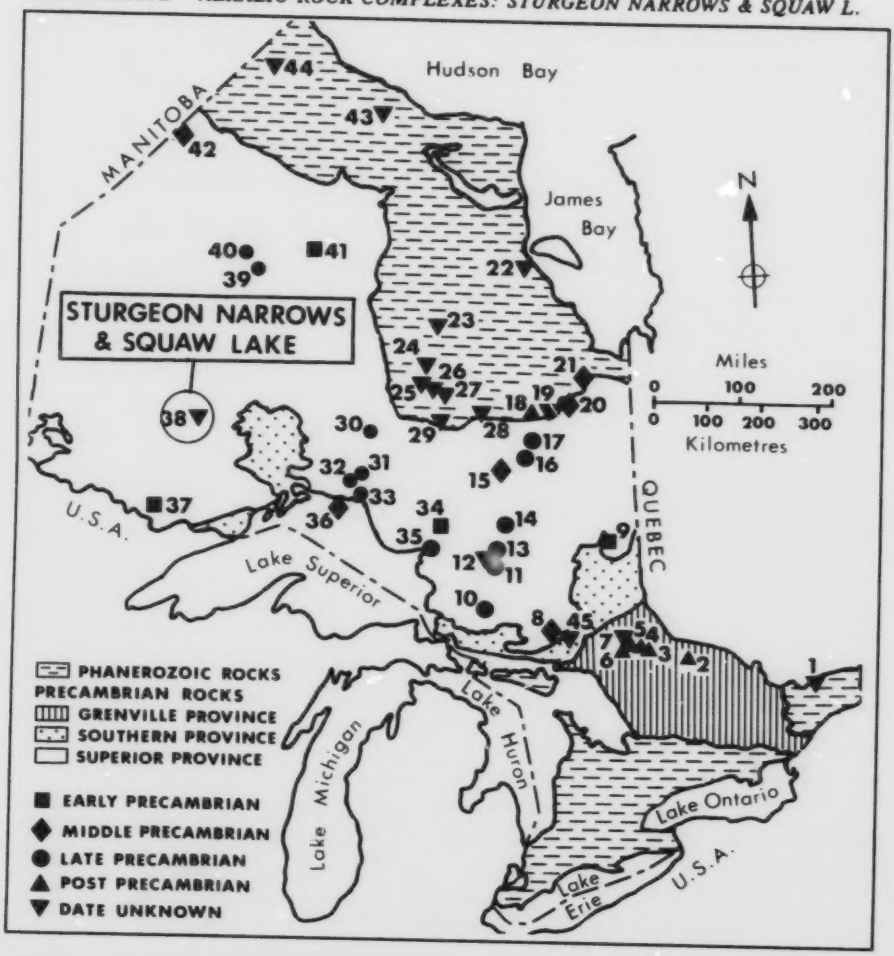

Figure 1. *Key map showing location of carbonatite - alkalic rock complexes in Ontario.*

1. *Eastview*
2. *Brent*
3. *Callander B.*
4. *Manitou Is.*
5. *Burritt Is.*
6. *Iron Is.*
7. *Lavergne*
8. *Spanish R.*
9. *Otto Stock*
10. *Seabrook L.*
11. *Lackner L.*
12. *Borden Tp.*
13. *Nemegosenda L.*
14. *Shenango Tp.*
15. *Cargill Tp.*
16. *Teetzel Tp.*
17. *Clay-Howells*
18. *Hecla-Kilmer*
19. *Valentine Tp.*
20. *Goldray*
21. *Argor*
22. *Lawashi R.*
23. *Poplar R.*
24. *Albany Forks*
25. *L. Drowning R.*
26. *Kingfisher R. West*
27. *Kingfisher R. East*
28. *Martison L.*
29. *Nagagami R.*
30. *Chipman L. (dikes)*
31. *Killala L.*
32. *Prairie L.*
33. *Port Coldwell*
34. *Herman L.*
35. *Firesand R.*
36. *Slate Is.*
37. *Poohbah L.*
38. **Sturgeon Narrows & Squaw L.**
39. *Schryburt L.*
40. *Big Beaver House*
41. *Wapikopa L.*
42. *"Carb" L.*
43. *Gooseberry Br.*
44. *Niskibi L.*
45. *Nemag L. & Lusk L.*

by diamond saw to remove weathered surfaces, fractures, and dikes and inclusions.

The thin sections were stained for potassium feldspar. Staining has enhanced the identification of the feldspars but has obscured the identification of the feldspathoids and zeolites in a number of cases. Time limitations prevented an in-depth study of the thin sections. A brief description of each thin section prepared from a rock submitted for total rock analysis appears in Table A-1 (Appendix A).

Nomenclature

Nomenclature used in mapping alkalic rock – carbonatites of Ontario is modified after that of Parsons (1961). The author has used a somewhat different nomenclature in the present report, in conformity with the nomenclature used in describing other alkalic rock – carbonatite complexes in northern Ontario. For the alkalic rocks, the author prefers to use mineralogic, colour, or textural modifiers, which are familiar to all readers, rather than unfamiliar rock names. Alkalic rock nomenclature is cumbersome, due in large part to the profusion of unfamiliar rock names. Consequently, as an aid to the reader, the use of less familiar rock names will be limited. The rock terms retained by the author and the way they are used are given below.

Ijolite. A nepheline–pyroxene rock with a nepheline content between 30 and 70%. Rocks containing more than 70% nepheline are classified as urtite and those with less than 30% as melteigite. Some specimens may contain significant amounts of biotite in place of pyroxene. Potassium feldspar content is 10% or less and those rocks with 10% or less nepheline are classified as pyroxenite.

Malignite. A melanocratic nepheline syenite. In general, nepheline, pyroxene and potassium feldspar occur in roughly equal proportions. The potassium feldspar content must exceed 10% or the rock is classified as belonging to the ijolite suite. Both the nepheline and pyroxene content must exceed 10% or the rock would be classified with the syenites. This rock group is transitional between the ijolites and overlaps the syenitic rock groups.

Sovite. A carbonatite rock composed of 50% or more calcite. Various mineralogic modifiers are used to classify the sovite, for example, apatite–magnetite sovite, olivine–amphibole sovite, etc.

Silicocarbonatite. A carbonatite rock containing 50% or more oxide and silicate minerals. Where the silicate or oxide minerals make up more than 90% of the rock, various other rock names are applied; i.e. ijolite, biotite, pyroxenite, etc.

Syenite. This term is restricted to a quartz-free rock consisting primarily of alkali feldspars. Various mafic minerals and nepheline may be present and form a significant component of the rock. The syenites are named on the basis of their mineralogy, i.e., pyroxene–nepheline syenite, biotite–amphibole syenite, etc. The syenites are gradational into malignites.

There is no standard subdivision of the ijolite suite into ijolite, urtite, and melteigite. Bailey (1974) classified urtites as having more than 70% nepheline, however he used the term ijolite to apply only to those rocks containing between 50 and 70% nepheline. The author finds this range to be too restricted for field use and prefers the 30 to 70% range given by Williams *et al.* (1954, p.70).

Malignite from the Poohbah Lake complex in northwestern Ontario was originally defined by Lawson (1896) as an alkali-rich rock containing pyroxene, and

potassium feldspar, with or without nepheline, garnet and amphibole. The author has examined the malignite of this complex in the field and in a large number of thin sections. The malignites are melanocratic and contain pyroxene, nepheline, orthoclase, garnet, and amphibole. The nepheline content of the type location is relatively low compared with the definition given above. For field work and to better emphasize the gradational nature of malignite into ijolites and syenites without the use of cumbersome terminology, a broader usage of the term has been applied by the author. Williams *et al.* (1954, p.65–66) described a number of malignites of varying mineralogy.

The Poohbah Lake type location for malignite was re–investigated by Mitchell and Platt (1978) and malignite was redefined by them as a nepheline syenite containing oikocrystic potassium feldspar. The author considers the definition of Mitchell and Platt too restrictive. The term malignite is used by the author for a melanocratic nepheline syenite as defined by Sorensen (1974, p.27).

The definitions of sovite and silicocarbonatite are modified from Heinrich (1966, p.12). The author has found Heinrich's subdivision of the carbonate–rich carbonatitic rocks generally suitable for field usage when modified to a two–fold subdivision at about 50% oxide and silicate mineral contents. The two–fold subdivision is more convenient than the four–fold subdivision of Heinrich (1966) because carbonatites show extreme variations in mineral content over distances of less than a few centimetres. It is difficult to rigorously classify such heterogeneous rocks.

General Geology

The Sturgeon Narrows Alkalic Rock Complex is tadpole–shaped, elongated in a northeast direction with the "tail" pointing southwest. The complex covers a surface area of approximately 31 km^2. The Squaw Lake Alkalic Rock Complex is circular in outline and covers a surface area of approximately 4.5 km^2. The shape of these two alkalic rock complexes is illustrated by the contours on aeromagnetic maps (Figure 2a,b). Table 1 lists the lithologic units of the complexes and their host rocks. Figure 3 (Chart A, back pocket) is a geological map of the complexes.

Trowell (1976, 1983) subdivided the rocks of the Sturgeon Narrows complex into four groups: inner syenite, outer syenite, inner leucosyenite, and syenogabbro–syenodiorite. The following summary of petrography is largely extracted from Trowell (1983) with modifications by the author. The inner and outer syenites are grey coloured, coarse grained, massive, equigranular, and consist of orthoclase,

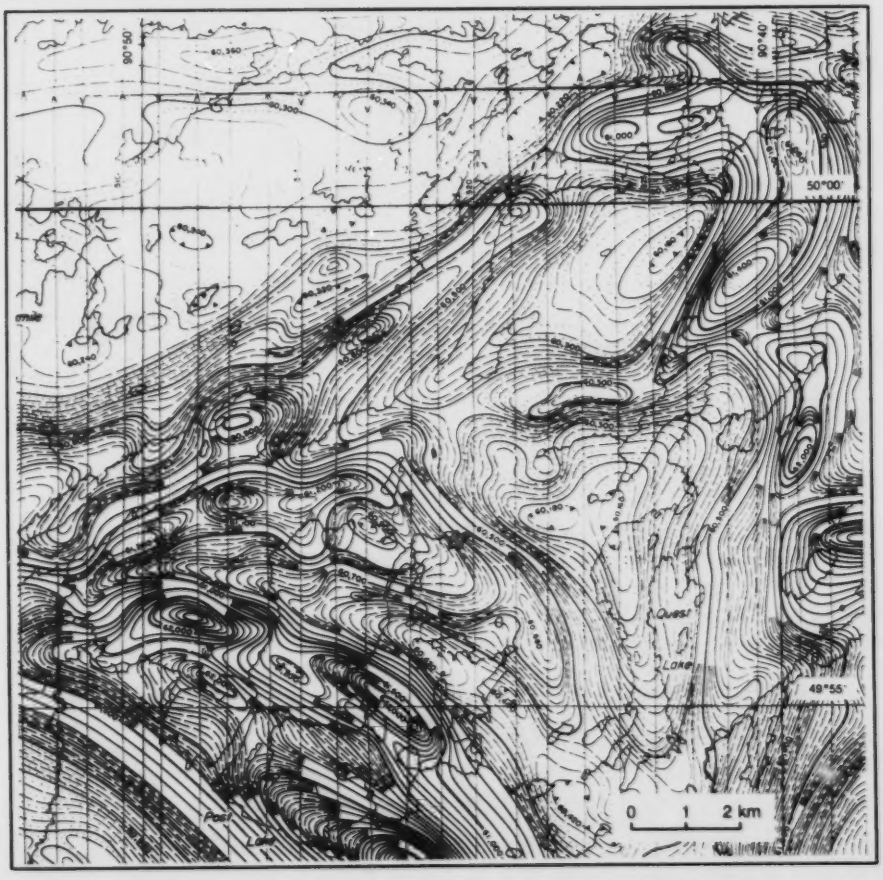

Figure 2a. *Aeromagnetic map of the Sturgeon Narrows Alkalic Rock Complex, from aeromagnetic maps 1117G and 1118G (ODM–GSC 1961a,b).*

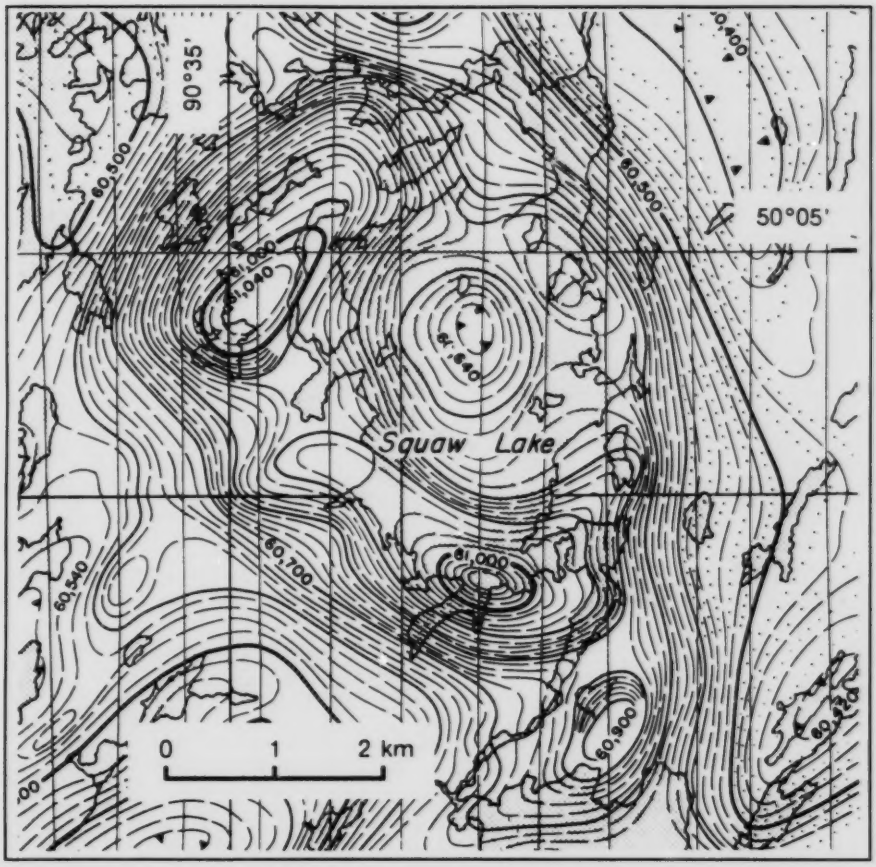

Figure 2b. *Aeromagnetic map of the Squaw Lake Alkalic Rock Complex, from aeromagnetic map 1118G (ODM-GSC 1961b).*

microcline–microperthite, altered nepheline, pyroxene and biotite. Minor interstitial plagioclase and garnet are also present. The mafic components vary from 10 to 25% of the rock. The outer syenites have a better developed trachytoidal texture and have a higher mafic content than the inner syenites, otherwise the inner and outer syenites are the same and gradational into each other.

The inner, leucocratic syenite is pink coloured, fine to coarse grained, inequigranular–porphyritic–seriate, and consists of orthoclase, perthite interstitial to plagioclase, with minor muscovite, biotite, carbonate, sphene, pyrite, magnetite and apatite. Trowell (1983), on the basis of thin section examination, classified rocks within this group as varying from syenite to monzonite.

The syenogabbro or syenodiorite occurs in the northeast corner of the complex and is pink coloured, medium to coarse grained, massive, equigranular to slightly porphyritic. The rock is composed of plagioclase with a mafic content varying from 20 to 70%, dominantly pyroxene and biotite. This rock group contains accessory magnetite, sphene and apatite and is cut by syenite dikes.

TABLE 1. TABLE OF LITHOLOGIC UNITS FOR STURGEON NARROWS AND SQUAW LAKE ALKALIC ROCK COMPLEXES.

CENOZOIC

Recent

Swamp, stream and lake deposits.

Pleistocene

Glacial deposits, boulders, gravel, sand, silt.

Unconformity

EARLY PRECAMBRIAN (ARCHEAN)

Alkalic Intrusive Rocks

Squaw Lake Alkalic Rock Complex

Syenite, nepheline syneite, monzonite, quartz monzonite, hybrid rocks.

Sturgeon Narrows Alkalic Rock Complex

Dike Rocks
Lamprophyre; aplite, feldspar-porphyritic aplite; feldspar pegmatite.

Inner Syenite
Nepheline syenite, fine to medium grained, leucocratic; syenite, leucocratic.

Outer Syenite
Syenite, coarse grained, locally trachytoidal; nepheline syenite, medium grained, locally trachytoidal.

Syenodiorite
Syenodiorite, fine to medium grained, locally trachytoidal; syenodiorite with biotite porphyroblasts?; syenodiorite with poorly defined mafic banding.

Xenolithic Rocks
Xenolithic syenite, syenodiorite; breccia, carbonatized breccia.

Intrusive Contact

Mafic intrusive rocks.
Metagabbro, metadiorite; porphyritic metagabbro, metadiorite.

Intrusive Contact

Metasediments
Arenite, wacke, conglomerate, argillite, chert, and their metamorphosed equivalents.

Metavolcanics

Felsic to Intermediate Metavolcanics

Flows; tuff, lapillistone, breccia; porphyritic flows and dikes.

Mafic to Intermediate Metavolcanics

Flows; gabbroic rocks; tuff, lapillistone, breccia; autoclastic breccia; pillowed flows; vesicular and amygdaloidal flows.

Trowell (1983) reported feldspathization and development of blue-green amphiboles along the margins of the Sturgeon Narrows intrusion. This alteration is best developed on Seaton Island, Coveney Island and the middle island along Sturgeon Narrows and is best seen in thin section rather than in outcrop. The author saw little visual evidence of alteration of the wall rocks in the exposures visited.

Spectrographic examination of carbonate samples collected from fracture fillings in the Sturgeon Narrows Alkalic Rock Complex failed to disclose significant concentrations of trace elements such as Sr and Ba (Trowell 1976) characteristic

of carbonatite (Heinrich 1966, p.225–228) and thus the source of the carbonate fillings is not likely carbonatitic intrusions.

The rocks of the Squaw Lake intrusion have been divided by Trowell (1983) into two broad groupings: coarse–grained to pegmatitic alkalic phases of syenite and monzonite in the north half of the intrusion and medium–grained, equigranular, quartz–bearing syenite, syenomonzonite and monzonite in the south half. Trowell (1983) identified a 60 m zone of contact metamorphism and metasomatism in felsic metavolcanic rocks flanking the Squaw Lake complex on the north side.

Trowell (1983) concluded that the Sturgeon Narrows and the Squaw Lake complexes are probably comagmatic; the author concurs with this.

EARLY PRECAMBRIAN

METAVOLCANICS

Mafic to Intermediate Metavolcanics

The mafic to intermediate volcanic flow rocks are generally fine grained and weather black, greenish black, green, or greenish brown. On fresh surface they are various shades of green and black. Fine–grained, equigranular, massive flow units lacking primary structures (Unit 1a) are subdivided from those of coarser grain size (Unit 1c) which are likely thick flow centres. Flow rocks containing phenocrysts (Unit 1d) are easily subdivided from the other flows as are those flows displaying pillow structures (Unit 1h).

Mafic fragmentals have been split into two groups (Trowell 1976, 1983). Autoclastic breccias (Unit 1f) are likely flow top breccias. These breccias consist of angular clasts 5–10 cm in diameter set in a chloritic matrix (N.F. Trowell, Ontario Geological Survey, 1977, personal communication). Undifferentiated mafic breccias of unknown origin (Unit 1p) are subdivided from the autoclastic breccias. Tuff, lapillistone, and pyroclastic breccias of mafic to intermediate composition (Unit 1e) have been grouped into one lithology. These breccias are composed of ash, lapilli–sized fragments, and an occasional larger clast. Some of these fragmental units are, in part, hyaloclastic (Trowell, 1977, personal communication). Amygdaloidal flow rocks (Unit 1j) occur in isolated widely scattered outcrops. Amygdaloidal units have been recorded on the diamond drill logs of Texmont Mines Limited from drilling near the Sturgeon Narrows Alkalic Rock Complex (Assessment Files Research Office, Ontario Geological Survey).

Texturally, the mafic to intermediate metavolcanics are very fine grained, equigranular, massive, allotriomorphic, with curved grain boundaries. They consist of plagioclase of albite–oligoclase composition, epidote, biotite, actinolite, hornblende and trace amounts of magnetite.

A thin section prepared from a sample collected at the northeast end of Coveney Island contains an estimated 30% or more of anthophyllite that may be indicative of a high magnesium content. Minor quartz is present in several sections and the plagioclase is commonly saussuritized.

Felsic to Intermediate Metavolcanics

The felsic to intermediate metavolcanics (Unit 2) weather white, pink or buff and have a blocky weathered appearance. On fresh surfaces, the rocks are buff, pale green to pale pink.

Units consisting of structureless homogeneous lithology and those containing phenocrysts, principally of quartz, are interpreted to be flows and are not subdivided (Unit 2a). Units consisting of lapilli–size lithic fragments and crystal fragments (Unit 2b) are subdivided from coarser fragmentals (Unit 2c). Marginal to the Sturgeon Narrows and Squaw Lake complexes, felsic to intermediate metavolcanics form only a minor lithology.

Thin sections of the felsic unit were not examined by the author and the reader should refer to Trowell (1976) for petrographic data.

METASEDIMENTS

Metasediments (Unit 3) are abundant in proximity to the Sturgeon Narrows complex. Exposures are present on small islands along Sturgeon Narrows, on the west shore of Sturgeon Narrows, and along the east flank of the Sturgeon Narrows complex.

On islands in Sturgeon Narrows several exposures of arenite (Unit 3a) are present. These rocks consist of angular to subangular grains of quartz and plagioclase in a sericite–rich groundmass. The groundmass is too fine–grained for optical identification of all the minerals present.

Actinolite, epidote, opaques, limonite, and carbonate have been identified in the groundmass. The author classified the rocks as arkose (>25% feldspar), feldspar–bearing quartz sandstone (<10% feldspar) and rarely argillite (approximately 10% quartz grains in a fine–grained, recrystallized matrix). The quartz and feldspar grains display fracturing and wavy extinction indicating strain. The deformation has likely resulted from movements along the fault running down Sturgeon Narrows.

On the islands in Sturgeon Narrows, the outcrop surfaces weather grey. The metasediments are bedded, locally cross–bedded. Isolated round clasts of argillite and felsic volcanic rocks are present in one exposure found on the islands within Sturgeon Narrows. The largest clast observed is 15 cm in diameter. The metasediments at the northeast end of Seaton Island display a poorly developed bedding. With increasing content of lithic fragments and/or matrix, arenite is gradational into wacke.

On a small island in the centre of the Sturgeon Narrows a mixed sequence of argillite to conglomerate was observed. The argillite (Unit 3d) lacks any evidence of bedding and contains clasts up to 15 cm in diameter, largely of mafic volcanic rocks. Some chert fragments 1 cm in diameter and several very fine–grained felsic clasts are also present. The clasts are rounded to subrounded in shape.

Trowell (1983) described the conglomerate along the east side of the Sturgeon Narrows complex as having a high mafic component, containing clasts of gabbroic and mafic volcanic rocks. The unit lacks bedding, has a lithic wacke matrix, and is poorly sorted (Trowell 1976, 1983). The matrix of this unit contains 80% fine mafic clasts, and 10–20% fine–grained quartz, feldspar, and chlorite (Trowell 1976).

The chaotic structureless appearance of the unit prompted Trowell (1983) to propose the possibility that this unit represents a laharic or debris flow. The conglomeratic unit contains minor amounts of arenite, greywacke, and argillite.

The metasediments east of the complex intertongue with mafic metavolcanics towards the west along the southern margin of the Sturgeon Narrows intrusion. The sediments were likely locally derived from the associated supracrustal rocks.

Quartzite and chert (Unit 3j) do not occur in outcrop but are recorded on the diamond drill logs of Green Point Mines Limited and Consolidated Red Poplar Mines Limited (Assessment Files Research Office, Ontario Geological Survey). Rock types logged as quartzite and novaculite have been lumped together and coded as chert by the author. The logs indicate that the rock is fine grained, dense, thinly bedded, and grey to black in colour. The same logs report the presence of a dark green, hard, dense rock (Unit 3p) logged as tactite by Green Point Mines Limited and Consolidated Red Poplar Mines Limited (Assessment Files Research Office, Ontario Geological Survey).

Some outcrops of argillaceous metagreywacke have a spotted appearance (Unit 3m). These grains or spots are approximately 3 by 1.5 mm in diameter and have been tentatively identified as the retrograde product (quartz, feldspar, and white mica) of the breakdown of staurolite or andalusite (Trowell 1976).

MAFIC INTRUSIVE ROCKS

The mafic intrusive rocks (Unit 4) were not examined in the field by the author and the following description is condensed from Trowell (1976).

The rocks weather grey to grey–green and are green to grey–green on fresh surfaces. They range from fine to coarse grained and have a subophitic, equigranular, or porphyritic texture. The rocks are composed of plagioclase, amphibole, quartz, myrmekite, chlorite, epidote, carbonate, titanite and opaque oxides and sulphides. The plagioclase is saussuritized and the amphibole occurs both as euhedral phenocrysts and fibrous laths. On the basis of the mineral assemblage epidote–carbonate–chlorite, Trowell (1976) concluded that the mafic intrusions had been metamorphosed under greenschist facies conditions.

Porphyritic varieties contain greenish to buff saussuritized plagioclase phenocrysts in a dark green matrix. They vary from microporphyritic varieties to those containing feldspar crystals up to 0.3 m across (Trowell, 1977, personal communication). The average phenocryst is approximately 5 cm in maximum dimension. Some exposures show a distribution of sizes of the phenocrysts that may be related to flow at the time of emplacement. Trowell (1977, personal communication) classed some of the porphyritic mafic rocks as anorthositic gabbros.

ALKALIC INTRUSIVE ROCKS

Sturgeon Narrows Alkalic Rock Complex

The Sturgeon Narrows Alkalic Rock Complex has been investigated by a number of individuals in the past. Since Trowell (1976, 1983) has discussed these reports, the present report will emphasize the new data obtained by Trowell (1976, 1983), and the author.

Trowell (1983) subdivided the complex into 4 units: feldspathoidal outer syenite, feldspathoidal inner syenite, feldspathic inner leucosyenite, and syenodiorite. The author combined the outer and inner syenites into one outer syenite group and retained the remaining subdivisions of Trowell (1976).

Syenodiorite

Along the northeast flank of the Sturgeon Narrows complex is a lithology (Units 5j,n,p) distinctly different from the medium– to coarse–grained nepheline–rich syenite rocks that compose the bulk of the Sturgeon Narrows complex. This unit

is massive, fine to medium grained, equigranular to inequigranular–porphyritic–seriate, and weathers various shades of brown, pink, grey, green and reddish brown. On fresh surfaces, the rock is pink–brown to brown–pink, and generally has a mafic index of 25% or more. This unit is best exposed in the southeast corner of East Bay immediately east of Coveney Island, and is present in very limited extent on the mainland east and south of Seaton Island. Trachytoidal textures are present but not as well developed as in the coarse–grained outer syenite.

In thin section the rock is fine to medium grained, equigranular, massive, allotriomorphic, with curved grain boundaries. The mode of the syenodiorite is estimated to be 10–60% plagioclase, 5–55% microcline, 0–25% clinopyroxene, 0–35% amphibole, and 5–35% biotite.

Plagioclase of albite to oligoclase composition is the dominant feldspar and it locally displays weak saussuritization. Microcline is the second most abundant feldspar. Perthitic microcline occurs in several sections and is stringy. Several thin sections contain clear colourless potassium feldspar identified as orthoclase, but it is possibly a cryptoperthite.

Clinopyroxene is one of the more common mafic constituents and it occurs as clear, colourless grains that exhibit lower extinction angles than a pale green clinopyroxene found in both the outer and inner syenites. The pyroxene, likely augite, is subhedral to anhedral. The larger augite grains have pale green rims indicating that they may be more sodic towards their margins. The pyroxene is locally mantled with dark brown amphibole or biotite. Where replacement has been extensive the pyroxene occurs only as relict grains enclosed within the amphibole and biotite.

A dark greenish brown amphibole is present in some thin sections. The dark greenish brown colour and strong pleochroism suggests a sodium–iron–rich variety. The amphibole occurs in distinct anhedral grains which may or may not be primary and also mantles the pyroxene. Replacement of pyroxene by amphibole is so extensive in places as to leave only relicts of the former pyroxene.

Biotite forms dark brown crystal aggregates and large grains. The larger grains, that may or may not be primary in origin, occur as clusters of anhedral grains. Several thin sections display biotite grains with a distinct kinking of the (001) cleavage plane. Some biotite forms irregular, ragged replacement mantles on pyroxene and sometimes on amphibole.

Polycrystalline fine–grained aggregates of biotite in association with colourless, turbid, fine–grained garnet and occasionally epidote are present in several thin sections. These polycrystalline aggregates represent the breakdown of the primary mineral phases and locally occurs in amounts up to 25%. It is uncertain whether the breakdown of the primary mafic minerals was related to late–stage deuteric effects within the crystallizing magma or was a response to a younger regional metamorphic event. Since similar breakdown relations have been observed by the author in other alkalic rock complexes and regional metamorphic effects are weak or absent, the author considers it most likely that the breakdown of the primary mafic minerals to biotite, amphibole and garnet is a late–stage deuteric phenomena.

One thin section contains an estimated 10% of dark brown garnet with subhedral to anhedral outline.

Nepheline was noted in only one thin section in amounts approaching 10%. This section came from a sample close to the syenodiorite–wallrock contact and is likely atypical.

Two thin sections contain an estimated 5% quartz as anhedral, interstitial grains. The quartz may be a late-stage primary mineral. Magnetite is also present in two thin sections in estimated amounts of 5%. Apatite, myrmekite, actinolite, sphene, fluorite, tourmaline, and chlorite are present in trace to very minor amounts in one or more thin sections.

Areas within the syenodiorite contain abundant xenolithic inclusions (Unit 5k). These inclusions are dominantly wallrock derived, but some could be chilled mafic early phases of the syenite complex.

At one or two outcrops the syenodiorite contains large irregular grains of biotite (Unit 5n). These biotite crystals are 0.5 to 5.0 cm in diameter, porphyroblastic in appearance, and poikilitically enclose the feldspars and other mafic components. This texture is rare. While the biotite grains have a porphyroblastic texture suggestive of metamorphic origin, the remaining minerals do not have a texture indicative of a high degree of recrystallization. The significance of the texture is uncertain.

East of Coveney Island, an outcrop of syenodiorite displays weakly defined mafic banding (Unit 5p). The bands are diffuse, on the order of 8 cm in width and are defined by varying feldspar-mafic ratios. This banding is interpreted by the author to be primary in origin and to have developed at the time of emplacement.

Outer Syenite

The outer syenites (Units 5a,b) comprise the bulk of the Sturgeon Narrows Alkalic Rock Complex and enclose a finer grained, more leucocractic core. The outer syenitic rocks are medium to coarse grained, weather grey to blue-grey, and have grey to blue-grey fresh surfaces. They are slightly mottled on fresh surfaces with blue-grey feldspars and dark green mafics. Those syenitic rocks containing significant quantities of altered nepheline have rough pitted weathered surfaces and on both fresh and weathered surfaces are mottled in blue-grey (feldspar), green to dark green (mafics) and buff to pale pink (altered nepheline). On outcrop the rock is coarse grained, equigranular to inequigranular-porphyritic-seriate, hypidiomorphic. The rock is generally massive but cataclastic zones that texturally could be classified as mylonite occur along its east flank at the south end of Sturgeon Narrows.

Trachytoidal textures are well developed in the marginal area of the intrusion. This trachytoidal texture is considered to be a primary flow lamination by the author and Trowell (1983) and is characterized by the subparallel to parallel orientation of tabular potassium feldspar crystals. On any given outcrop, variations in mafic-feldspar ratios may define a crude banding parallel to the trend of the oriented feldspar crystals. Inward from the periphery of the intrusion, the grain size decreases and the rock approaches medium grained. Trachytoidal textures disappear or become significantly less well developed and any visual evidence of variations in mafic-feldspar ratios disappear. The change in texture from coarse grained to medium grained and the absence of primary flow lamination textures forms the basis of the subdivision by Trowell (1983) into outer and inner syenites. The author, however, considers them to be completely gradational into each other.

On weathered surfaces, the nepheline-bearing phases display a deeply pitted surface where nepheline or its alteration products have preferentially weathered out. The alteration products of nepheline are buff, pale pink, pale red, or white and are best developed along the shoreline of Sturgeon Narrows on the east flank

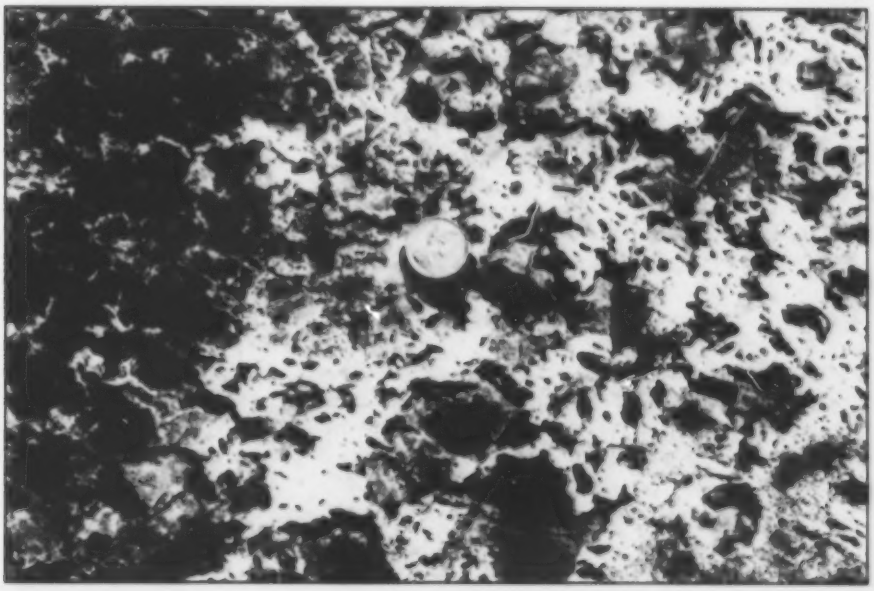

Photo 1. *Pegmatitic segregation in nepheline syenite. Nepheline is grey and weathers low; feldspar is light coloured and weathers high. Location P-3, Figure 3.*

of the complex. Pegmatitic segregations of very coarse-grained nepheline (altered) and feldspar locally occur within the coarse-grained syenites (Photo 1). Rarely these pegmatitic segregations have cavities that are lined with euhedral feldspar crystals and are filled with calcite. The cavities are likely filled miarolitic cavities. They were noted to reach diameters of 1 cm. On fresh surfaces the mafic content of the outer syenite varies between 10 and 25%. Nepheline-bearing syenites or syenites containing the alteration products of nepheline appear to be more abundant at the periphery of the intrusion, however, petrographic examination does not indicate any clearly observable decrease in nepheline (or alteration products) content towards the core of the complex. Nepheline-poor syenitic rocks and nepheline-rich rocks commonly occur in proximity to each other and appear gradational into one another.

In thin section, rocks of the outer syenite are fine to coarse grained, massive, inequigranular-seriate, allotromorphic, with curved to lobate grain boundaries. The grain boundaries interdigitate in the more deformed and recrystallized rocks. Thin sections prepared from the coarse-grained rocks cannot give a truly representative mode since the thin section covers too limited an area. The mode is estimated to be 5-75% plagioclase, 0-75% microcline, 0-80% perthite, 0-20% clinopyroxene, 0-15% amphibole and 0-40% biotite.

Plagioclase of albite-oligoclase composition forms part of the interlocking mosaic of anhedral feldspar grains. Some of the larger plagioclase grains display protoclastic textures characterized by bent albite twin planes. Microcline occurs in anhedral grains with well developed quadrille twinning. Microcline perthite shows a well developed stringy texture. Patch perthite likely represents potassium feldspar replacement of plagioclase. Untwinned, clear potassium feldspar is rare and is tentatively identified as orthoclase. The clear feldspar may prove to be cryptoperthite upon examination by X-ray diffraction. The feldspars, as a group, form an anhedral interlocking mosaic of grains with curved, lobate and inter-

digitating grain boundaries. The more sutured the grain boundaries, the more extensive the deformation and recrystallization. The feldspar textures suggest that a primary protoclastic texture has been overprinted by a deformation–recrystallization event that has obliterated primary grain boundary relationships. Some thin sections have feldspars that display extensive saussuritization. As a group, the plagioclase is more commonly saussuritized than the potassium feldspar.

Pale green clinopyroxene is present in the least deformed and recrystallized rock. The crystals are commonly mantled with dark green–brown amphibole and are replaced by aggregates of biotite, garnet, and epidote. The clinopyroxene is often zoned from pale green cores to darker green rims. This zoning implies an increase in the aegirine content towards the margin of the grains. Several thin sections contain colourless pyroxene in quantities up to 10%. This colourless pyroxene displays lower extinction angles than the pale green pyroxene and is most probably augite. Pale green clinopyroxene is by far the dominant of the two pyroxenes. The pyroxene forms subhedral to anhedral grains or relict cores in amphibole and/or biotite. Apatite is commonly poikilitically enclosed within the pyroxene.

Dark green–brown amphibole is present in quantities ranging from 0 to 15%. The deeply pleochroic colours of the grain suggests it is a sodic–iron variety. In several thin sections the amphibole mantles and replaces pyroxene, however in other grains the amphibole appears to possibly be a primary phase. The amphibole forms anhedral grains, is rarely subhedral, and the grains locally have somewhat ragged edges.

Biotite occurs as interlocking books that in places display kinking of the (001) cleavage. Where the crystals form large distinct books, the biotite is likely a primary phase, and in this form the biotite comprises 0 to 40% of some thin sections. In other instances biotite forms fine–grained felty aggregates, undoubtedly having replaced a primary mafic phase, and in other instances occurs as part of fine–grained polycrystalline aggregate in association with garnet, epidote, and actinolite. The polycrystalline aggregates replace both amphibole and pyroxene. Biotite–garnet aggregates are the most common and those containing epidote the next most common. Actinolite is uncommon to rare within the aggregates and may reach 5% of the section. The garnet is fine–grained, turbid, colourless, and has anomalous birefringence even though most of the individual grains remain at extinction under crossed nicols. The identification of the epidote is somewhat questionable due to its small grain size but birefringence and one optic determination best fit epidote. Epidote rarely exceeds 5% of a thin section and occurs as isolated grains as well as in aggregates with biotite and garnet. The garnet may be a grossularite variety and appears to be the result of the breakdown of a primary mafic phase, most likely pyroxene or amphibole. The polycrystalline aggregates occur in amounts of 0 to 25%.

A second variety of garnet was rarely noted in amounts up to 5%. This garnet is a dark brown, subhedral variety generally much larger in grain size than the colourless, fine–grained garnet associated with biotite. This garnet may be either a primary magmatic phase or a breakdown product of a primary mafic mineral. Probe analyses reported by Trowell (1976) indicate that the garnet is an andradite (Table 2). Probe studies also indicate that the garnet is compositionally zoned, but the nature of this zoning was not specified. The dark brown garnet occurs in association with pyroxene, sodic amphibole, and biotite.

Nepheline occurs as anhedral clots interstitial to the feldspar grains. Where fresh, the mineral is colourless and characterized by abundant parallel to sub-

TABLE 2. MICROPROBE ANALYSES OF GARNET FROM INNER NEPHELINE SYENITE OF THE STURGEON NARROWS ALKALIC COMPLEX. FROM TROWELL (1976).

	Garnet 1	Garnet 2	Garnet 3	Garnet 4	Garnet 5	Garnet 6	Average
Fe	29.75	31.57	27.37	28.59	27.83	27.98	28.83
Si	34.99	35.17	35.49	36.72	36.96	36.60	35.98
Ca	35.32	34.58	35.41	35.41	33.64	31.75	33.98
Al	1.98	1.37	1.83	3.23	4.15	6.34	2.45
Total	102.04	102.69	100.00	102.18	102.08	102.67	101.24

Ion	Numbers of Ions*	
Fe^{3+}	1.79	1.95
Al	0.16	
Al	0.03	3.00
Si	2.97	
Ca	3.02	3.02

* Number of ions based on 12 oxygen (calculated from the average).
Analyses by D.H. Watkinson, Carleton University, Ottawa.

parallel inclusions. The inclusions are too small to be positively identified by optical methods. Gledhill (1925, p.36) noted these inclusions and suggested the possibility that they were augites. Pleochroism and extinction suggest to the author that some may be tourmaline, some apatite, and others perhaps a feldspar. Fresh nepheline is best preserved within the interior and eastern flank of the Sturgeon Narrows complex. Staining for potassium feldspar often destroyed the nepheline preventing further study in thin section.

Cancrinite is a common feldspathoid and occurs in amounts of 0 to 20%. It is by far the most abundant feldspathoidal mineral present. It forms anhedral, clear grains and lacks any visual evidence of strain even in those rocks that have obviously been affected tectonically. The author considers the mineral to be an alteration of the nepheline along the western flank of the complex where it weathers buff to white in colour and occurs as powdery aggregates interstitial to the feldspar. Sodalite occurs in a manner similar to that of cancrinite. It occurs in quantities up to 10%. In the field the presence of sodalite is indicated by a deep blue colour in outcrop. This mineral was observed in float on Seaton Island and in outcrop at the point of land on the south shore at the entrance to the waterway leading into East Bay. As with cancrinite the author believes this mineral to be an alteration of the nepheline. Sodalite grains over 5 mm in diameter and displaying good cleavage have been observed. The presence of feldspathoids in much greater abundance along the west flank of the Sturgeon Narrows complex where deformation and recrystallization are most intense implies that these minerals are partly a product of deformation and recrystallization of the outer nepheline syenite.

Zeolites, as fibrous aggregates, are a common alteration product of nepheline. X-ray diffraction studies have identified natrolite and analcite (Trowell 1976). Most of the zeolite observed by the author was too fine grained for optical identification but its acicular habit is compatible with the identification as natrolite.

Sericite (gieseckite) forms fine-grained aggregates presumably after nepheline in several thin sections and may comprise up to 40% of a thin section. The sericite is interstitial to the feldspars. Sericite may occur with carbonate, epidote or other alteration products of nepheline.

Scapolite has been reported as a dominant mineral phase by Rogers (1964) but its presence in such quanitities was not confirmed by Trowell (1976) nor by the author. Several thin sections contain a mineral in quantities less than 4%, which is likely scapolite.

Sphene as anhedral to subhedral dark brown crystals is a common accessory mineral. It rarely approaches an estimated 3% of any given thin section. The crystals display a parting and generally are wedge-shaped in outline.

Deep purple to almost colourless grains of fluorite are common as tiny interstitial grains in a large number of thin sections. It rarely exceeds an estimated 1% of the section. Its widespread presence suggests that the fluorine content of the Sturgeon Lake complex is high, relative to other similar alkalic rock complexes.

Zircon as tiny anhedral grains of moderate to high relief occurs in association with biotite. Zircons within the biotite commonly display dark haloes resulting from the radioactive bombardment and breakdown of the biotite. Some of the radioactive bombardment haloes are around apatite grains, implying the presence of a radioactive element in the apatite.

Apatite occurs as euhedral crystals poikilitically enclosed within pyroxene and amphibole, and in association with polycrystalline aggregates of biotite, garnet, epidote and actinolite which resulted from the breakdown of pyroxenes and amphiboles that originally enclosed the apatite.

Calcite as interstitial, euhedral grains is present in a number of thin sections in amounts usually less than 1%. Thin sections of mylonized syenite indicate a carbonate content approaching 15% in some cases. This carbonate has likely been introduced during or after tectonism. Chlorite, limonite, myrmekite, magnetite and pyrite were noted in one or more sections in quantities of 1% or less. Moore (1911, p.155) also reported the presence of topaz and zinnwaldite.

The areas of outer syenite which contain abundant xenoliths have been mapped as Unit 5h. The xenoliths consist predominantly of two types: (1) metasomatized wall rocks and (2) fine-grained, mafic-rich syenite clasts, probably an earlier chilled facies of the syenite intrusion (Photo 2).

At several exposures along the shoreline of Sturgeon Narrows leucocratic, medium-grained nepheline syenite and coarse-grained nepheline syenite are intimately mixed. In two outcrops the coarse-grained phase appears as xenoliths within the medium-grained phase. The author considers these two phases to be essentially contemporaneous in emplacement representing magmatic pulses of similar composition. The true age relations remain to be established. The medium-grained phase may in part be a chilled contact phase and/or a late stage in the evolution of the alkalic magma.

Inner Syenite

Within the centre of the Sturgeon Narrows complex is a distinctly different syenite (Units 5c,d,e) which is finer-grained and more leucocratic than the outer syenite. It forms rounded outcrops and low hummocks above a relatively flat terrain. The rock is fine to medium grained but locally contains coarse-grained pegmatitic segregations. This syenite was subdivided in the field into two types on the basis of absence or presence of visually identifiable nepheline. Nepheline-

Photo 2. *Elliptical xenolith of early formed mafic phase in nepheline syenite. Note dark reaction rim. Location P-1, Figure 3.*

bearing (Unit 5c) and nepheline-poor (Unit 5d) phases are gradational into each other, often within the same outcrop, and are thus fundamentally part of the same lithologic unit. In outcrop these map units do not display the well developed trachytoidal textures that characterize the outer coarse-grained syenites along the periphery of the complex.

On weathered surfaces the inner syenites are white, buff, to pale pink and on fresh surfaces, the same colours are present. Macroscopically the rock is fine to medium grained, equigranular, massive, hypidiomorphic.

In thin section the rock is fine to medium grained, equigranular, massive, alliotriomorphic, with curved to interdigitating grain boundaries. The better the development of protoclastic textures, the greater the development of interdigitating grain boundaries. A visual estimate of the mode is 0–80% plagioclase, 0–55% microcline, 0–25% clinopyroxene, 0–25% biotite, 0–20% garnet and 0–20% nepheline.

Plagioclase of albite–oligoclase composition is by far the dominant feldspar present. Plagioclase comprises up to an estimated 80% of any given thin section and only rarely does microcline, the second most abundant feldspar, equal or exceed the plagioclase content. The microcline displays a well developed stringy perthite texture. Several thin sections contain minor quantities of clear, untwinned potassium feldspar. This feldspar may be orthoclase but the author suspects that X-ray diffraction would show it to be cryptoperthite. The feldspars form anhedral grains and occur as an interlocking mosaic of grains.

Pale green clinopyroxene is commonly present in less than half of the thin sections and is considered by the author to be a primary crystallizing phase. The larger pyroxene grains are often zoned from pale green to colourless cores to much darker green rims. The colour change is gradual and perhaps best displayed on grains cut normal to the "c" crystallographic axis. In one thin section augite cores are mantled with green pyroxene, possibly aegirine-augite. In this one thin

section the contact between the two pyroxene types was sharp and cuspate suggesting replacement or reaction with late–stage sodium–iron–rich solutions. The pale green pyroxene is commonly altered to biotite, colourless garnet, and epidote. Actinolite may also be part of the alteration assemblage.

Biotite forms dark brown crystals of fine to medium grain size. Where it occurs as distinct books of mica or as isolated grains or clusters of grains, it may have formed as a primary mineral phase. The biotite often forms fine–grained, polycrystalline aggregates commonly in association with garnet, epidote, and actinolite. These polycrystalline aggregates appear to be largely the result of breakdown of a primary mafic mineral phase, most likely clinopyroxene, and comprise up to 20% of a section.

Garnet is the most common mineral phase associated with biotite in these aggregates. Where biotite is largely absent, colourless turbid garnet may comprise most of the aggregate. It is fine–grained and is isotropic throughout most of the grain but displays anomalous birefringence along the edges. The colourless, turbid nature of the garnet grains suggests that it may be grossularite. The garnet also occurs independent of the biotite as small aggregates of interlocking grains.

Epidote is an uncommon breakdown product associated with the biotite and garnet. Actinolite is rarely present.

As with the outer syenites, the inner syenites also contain dark brown garnet. This garnet is subhedral to anhedral in outline and may comprise an estimated 20% of some thin sections. The dark brown garnet is likely a primary mineral phase. Trowell (1976) reported that this garnet is of the andradite type.

Nepheline is present in a number of thin sections as clear, interstitial grains in quantities estimated at 20%. The nepheline forms anhedral grains between the feldspar grains.

Cancrinite, most likely after nepheline, occurs in several thin sections in amounts up to 15%. Cancrinite occurs as clear, colourless, interstitial grains similar to nepheline. Staining for potassium feldspar has destroyed or clouded the feldspathoid mineralogy in a number of thin sections making optical work difficult. The feldspathoid content is much less in the inner syenite than in the deformed outer syenite along Sturgeon Narrows.

Zeolites as fibrous acicular aggregates are an uncommon alteration product of nepheline within the interior syenite.

Disseminated purple to colourless fluorite in quantities approaching 1% is present in some thin sections. Zircon as tiny inclusions in biotite is present in several thin sections. Where present, the zircon displays dark rims or haloes resulting from radioactive bombardment of the biotite. At no place does the zircon exceed an estimated 1%. Dark brown sphene as wedge–shaped euhedral to subhedral crystals is a common accessory mineral in amounts up to 2% in some sections. The sphene locally displays parting. Magnetite, scapolite, calcite, and apatite were noted in trace to minor amounts in one or more thin sections.

Dike Rocks

Late alkalic dikes were noted in several exposures of the complex. The dike rocks have been arbitrarily subdivided into two groups: lamprophyres (Unit 5f) and felsic varieties (Unit 5g). Insufficient measurements were taken to establish any general trends for the respective classes.

The lamprophyre dikes are small, varying from 5 cm to a maximum of 80 cm in width. The dikes cut the outer syenites and contain xenolithic inclusions of the

syenite. One small dike appears to be boudinaged (Photo 3). The petrologic relationship of the lamprophyre dikes to the syenite complex is problematic.

In outcrop the dikes weather down with respect to the syenite, are fine grained, and dark green–black to black in colour. On fresh surfaces they are dark green–black and biotite may be recognizable. The lamprophyres display sharp contact with the syenite rocks and could represent a much later period of magmatic activity unrelated to the evolution of the Sturgeon Narrows Alkalic Rock Complex.

In thin section the rocks are fine grained, massive, equigranular and allotriomorphic. Plagioclase of albite composition forms 40–70% of the rock, biotite 25–60% and carbonate approximately 5%. Fluorite, magnetite, and a reddish brown alteration are also present. The lamprophyre may represent a diabasic dike rock that has undergone pervasive metasomatism by alkaline aqueous fluids.

The felsic dikes can be subdivided into pegmatite and aplite, which may or may not contain feldspar phenocrysts. Thin sections were not prepared from the pegmatitic phases but several aplite–textured dikes were examined in thin section.

In outcrop the aplite dikes weather pink, pink–brown, and blue–grey. They vary from a few centimetres to 2 m in width and cut both the outer syenite and the syenodiorite. Small feldspar crystals on the order of 1 to 2 mm in length are, on occasion, noticeable in the wider dikes. The contacts of these dikes with the syenitic rocks of the complex are generally sharp.

In thin section the aplite dikes are generally very fine grained to medium grained, massive, equigranular, allotriomorphic with interdigitating grain boundaries. Plagioclase of albite composition forms an estimated 20–60% of the rock, and microcline, in part perthitic, 0–50%. Sericite, carbonate, biotite, epidote, and actinolite form major phases in one or more thin sections. The one dike that exhibits a porphyritic texture contains phenocrysts of plagioclase of albitic composition. The phenocrysts form an estimated 15% of the rock and have a seriate distribution within the groundmass. The general trend of these felsic dikes appears to be east.

Areas of irregular pegmatite diking occur at several locations within the complex. In a small cove on the east side of Sturgeon Narrows is an exposure of very coarse–grained pegmatite. The pegmatite consists of bluish grey microcline with cleavage faces up to 7 cm on a side. The pegmatite has gradational contact relations to the coarse–grained syenite and is clearly related to the Sturgeon Narrows Alkalic Rock Complex. Euhedral, dark brown zircons up to 3 mm in diameter are locally present. The enclosing coarse–grained syenite displays a well–developed trachytoidal texture.

On a small island in Sturgeon Narrows is a coarse–grained leucocratic pegmatitic syenite dike 27 cm in width. This dike is in sharp contact with the cataclastic textured, coarse–grained syenite which suggests that some late–stage pegmatites may post–date deformation. The outcrop is smooth and could not be sampled. The long dimensions of the feldspar crystals in this dike are oriented roughly normal to the contacts (Photo 4).

Xenolithic Syenite Rocks

A number of xenoliths were examined in thin section. These xenoliths fall into two categories: (1) hornfelsed wallrock; and (2) fine–grained, mafic phases of the syenite complex. The xenolithic inclusions appear largely restricted to the margins of the complex, but this observation could be a function of limited exposure

Photo 3. *Lamprophyre dike cutting coarse-grained syenite. The dike appears to have been boudinaged. Location P-5, Figure 3.*

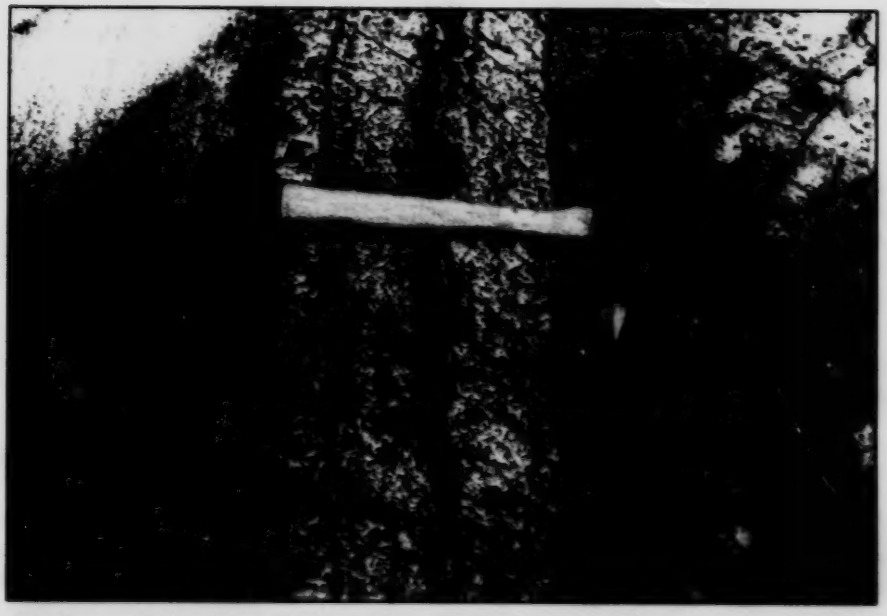

Photo 4. *Syenite dike (centre) cutting coarse-grained, banded syenite. Note feldspar phenocrysts oriented perpendicular to dike walls. Location P-6, Figure 3.*

within the interior of the complex. Texturally and mineralogically the fine–grained syenite inclusions appear identical to the coarse–grained phases that contain them.

The wallrock inclusions are fine–grained, equigranular, allotriomorphic with curved grain boundaries. Their grain size tends to be slightly larger than the unmetamorphosed wallrocks — presumably because of recrystallization due to contact metamorphosism. In thin section, the inclusions contain cancrinite (after nepheline?), microcline, and fluorite resulting from metasomatic solutions. Pyroxene noted in one thin section is mantled with a much darker green pyroxene. The darker green rim is presumably the result of sodium–iron metasomatism reflecting limited fenitization of the inclusions. In the thin section that has been most extensively fenitized, biotite has a poikiloblastic texture and partly mantles the sodic rim on the pyroxene.

Breccia zones (Unit 5m) occur at several places along Sturgeon Narrows. One exposure of breccia occurs on the northeast corner of Seaton Island. This breccia zone trends 040° and dips approximately 75° north. Syenitic rocks make up approximately 85% of the clast types and metavolcanic rocks comprise most of the remainder and reach a maximum size of 30 by 15 cm. Carbonate clasts up to 30 by 30 cm are a minor clast type. The breccia weathers brown which implies that the carbonate in the matrix is ferruginous. Some pyrite is present and its weathering may contribute to the brown colour. Trace amounts of fluorite are present and some greenish blue stains, possibly azurite, were noted. This breccia zone was probably formed after the emplacement of the Sturgeon Narrows complex and is likely related to faulting along Sturgeon Narrows.

A second breccia unit occurs on the mainland opposite the occurrence on Seaton Island. This outcrop is at water level and is poorly exposed. It consists of coarse–grained nepheline syenite xenoliths in a black matrix. The matrix weathers subdued with respect to the clasts and may be carbonate–rich as indicated by a strong reaction to hydrochloric acid. The zone trends parallel to the strike of Sturgeon Narrows and was traceable for a length of 12 m. The syenite clasts are rounded, slightly elongated, and reach a maximum size of 0.3 m. It is uncertain whether this breccia is related to nearby faulting along Sturgeon Narrows or whether it is representative of a late–stage diatreme event possibly related to emplacement of the Sturgeon Narrows complex.

Along the channel at the east end of East Bay, xenoliths occur in the outer syenite in such profusion along the contact that the outcrops were classified as intrusive breccia (Unit 5k). These exposures were distinguished by the author from the breccias at the entrance to Sturgeon Narrows to emphasize the possibility that these breccias are the result of different processes.

Fenitization

Trowell (1976) described sodic metasomatism of the wall rocks on Narrow Island, Coveney Island, Seaton Island and along the eastern contact of the complex. On Narrow Island, Trowell (1976) described the fenitic alteration of the greywacke and conglomerate metasediments on the island as one of replacement by perthite. Along the eastern contact of the complex, Trowell (1976) reported the development of a blue–green (sodic) amphibole mantle on original amphiboles and the formation of clot–like aggregates of colourless (tremolitic) amphibole, minor pyroxene, garnet and sphene. The sodium–iron metasomatism described by Trowell (1976) is weak relative to that observed by the author surrounding carbonatite intrusions.

On Seaton Island the effects of fenitization are restricted to the development of a pinkish hue in the metasediments. Trowell (1976) reported the presence of riebeckite in the Seaton Island metasediments.

The author concurs with Trowell (1976) that alkali metasomatism accompanied emplacement of the Sturgeon Narrows Alkalic Rock Complex.

Microcline, nepheline and/or cancrinite have been added to the inclusions and green to dark green rims added to the amphiboles and pyroxenes, presumably by alkaline aqueous fluids derived from the intruding syenite magma. Several attempts at determining plagioclase compositions within the xenoliths were made by optical techniques which suggest a soda–rich end member but a precise composition could not be determined. It is possible that some of the xenoliths classified as fine–grained mafic syenite may represent complete metasomatic replacement of wall rock.

The xenoliths are rounded to subrounded, lensoid in outline and reach a maximum size of 2 m in length. Most xenoliths are small and a few tens of centimetres in dimension. Several xenoliths have a dark greenish black selvage several millimetres thick and one small oval–shaped xenolith 17 cm in maximum dimension has a reaction rim 1 cm wide (*see* Photo 2). The reaction rim was identified in the field as amphibole which was dark–green to greenish black in colour, darker in colour than the amphibole in the core of the inclusion. The colour variation may be due to the colour and abundance of amphibole since the rim is composed of mostly dark amphibole while the core consists of a much more leucocratic appearing rock with the amphibole grains isolated and separated by light coloured feldspar grains.

The alteration in general largely reflects sodium, water, and possibly iron addition. The presence of a weak fenite halo around the Sturgeon Narrows complex is the first documented case of such a feature associated with an Early Precambrian complex within Ontario. The recognition of this feature at the Sturgeon Narrows Alkalic Complex may in large part be only a function of exposure and sampling since most of the other Early Precambrian complexes are poorly exposed and studied. The width of the metamorphic–metasomatic aureole around the Sturgeon Narrows complex is difficult to determine without more detailed study of closely spaced, thin–sectioned samples. Deformation has also obscured some of the areas along the contact and may have destroyed any original metamorphic–metasomatic mineralogy through retrograde dynamothermal metamorphism. The metamorphic–metasomatic aureole is not likely to exceed 10 or 20 m in width and is expected to vary in width depending on level of exposure with respect to its original form and the distribution of metasomatizing fluids.

Squaw Lake Alkalic Rock Complex

Nepheline syenite dominates in the northern and northwestern sections of the Squaw Lake Alkalic Rock Complex. The nepheline–bearing syenite is closely associated with and gradational into phases deficient in nepheline.

Syenite and Nepheline Syenite

The nepheline syenite (Unit 6b) on weathered surfaces varies in colour from buff to brown–red and on fresh surfaces is generally white to a mottled salt and pepper. Mineral grains are coarse, greater than 5 mm, and inequigranular with the mafic minerals smaller than and interstitial to the feldspars. Potassium feldspar and nepheline are the major components of the rock. Locally, nepheline is a minor phase where it is closely associated with interstitial biotite and pyroxene.

Nepheline syenite locally displays trachytoidal textures defined by the preferred orientation of the feldspars. Trachytoidal textures are absent in the remaining syenite units of the intrusive complex.

In thin section the rock is medium to coarse grained, massive, inequigranular–porphyritic–seriate and allotriomorphic. The mode is estimated to be 20–90% perthite, 20–70% microcline, 0–44% orthoclase, 0–25% sericite, 0–18% nepheline, 0–15% plagioclase (An 12–14), trace to 11% calcite, 0–8% amphibole, 1– 5% clinopyroxene, 0–2% iddingsite, 0–2% opaques (magnetite and pyrite), and trace amounts of sphene, apatite, epidote, garnet, olivine and scapolite.

Perthite, the main constituent of the rock, is patchy and anhedral in form, with irregular or curved grain boundaries. The perthite displays undulatory extinction. The perthitic feldspar crystals are sometimes euhedral in porphyritic and trachytoidal phases of the syenite.

Microcline, orthoclase and plagioclase are all closely associated with the perthite and form an interlocking mosaic of anhedral grains. The microcline displays characteristic quadrille twinning and the orthoclase lacks well developed twinning. X–ray diffraction studies of the orthoclase may disclose that it is actually a cryptoperthite. Plagioclase locally is finer–grained than the associated perthite, microcline, and orthoclase. Plagioclase commonly occurs as interstitial grains along irregular grain boundaries between the microcline and/or orthoclase.

Nepheline is found as anhedral to euhedral grains partially altered to sericite and unidentified zeolites. It occurs intergranular to and poikilitically enclosed within the feldspars.

Calcite occures as anhedral, colourless masses interstitial to the feldspars.

Biotite is inclusion–free except in one thin section where dark radioactive bombardment haloes surround poikilitically enclosed zircons.

Relict pyroxenes are anhedral and extensively altered to biotite and other micas. The clinopyroxene is green and has the extinction angles characteristic of aegirine–augite. Calcite and biotite are poikilitially enclosed within the clinopyroxene. The calcite and biotite grains are anhedral with irregular and curved boundaries.

Sericite is present as an alteration product of plagioclase and possibly nepheline. It occurs in three forms: (1) in the cores of larger plagioclase laths, (2) interstitially after fine–grained plagioclase and (3) after nepheline.

Cancrinite, likely an alteration product of nepheline, is anhedral, has irregular grain boundaries, and is interstitial to the coarser–grained feldspars. Trowell (1976) has interpreted some of the cancrinite to be primary.

Opaques are randomly distributed in thin section and have anhedral to euhedral outlines. The opaques are dominantly pyrite with minor magnetite. Trowell (1976) observed magnetite veinlets cutting natrolite–biotite–perthite syenomonzonite along the western margin of this complex. These veinlets are approximately 2.5 cm wide, dip at 60° with variable strike and are traceable over several feet. A sample from one of these veinlets was examined in the Geoscience Laboratories of the Ontario Geological Survey. The specimen is composed of magnetite set in a minor gangue of biotite, natrolite, analcite and pulverulent limonite. The analysis shows that the magnetite contains minor titanium, but no detectable quanitites of rare earths, thorium, uranium, or phosphorus, which can be concentrated in the veins cutting alkalic rocks. Magnetite–rich veins cutting the Late Precambrian alkalic rocks of the Lackner Lake Alkalic Rock Complex are titaniterous and contain high concentrations of the above elements.

Sphene is brown in colour and euhedral in outline. It is evenly distributed and is occasionally poikilitically enclosed within or associated with other mafic minerals. Iddingsite occurs as an alteration after olivine. Scapolite, apatite, epidote and garnet occur in trace amounts. Garnet, possibly grossularite, occurs as clear rounded grains in association with biotite. Quartz occurs as fine, interstitial grains and as capillary veinlets less than 1 mm wide.

Nepheline–poor syenite (Unit 6a) in contrast with nepheline–rich syenite (Unit 6b) is medium–grained, massive, homogenous, pink on weathered surfaces and white on fresh surfaces. It locally contains more potassium feldspar than the nepheline syenite. The nepheline–poor syenite is located along the northern and western margins of the Squaw Lake Alkalic Rock Complex. The nepheline–poor syenite is gradational into the nepheline syenite and no sharply defined cut–off or break exists between the two types.

Minor quantities of unidentifiable zeolites in some thin sections of nepheline–poor syenites are interpreted to result from the alteration of the minor amounts of former nepheline.

Trowell (1976) identified sodalite in one sample which has been confirmed by X–ray diffraction analysis by the Geoscience Laboratories, Ontario Geological Survey.

The zeolites within the nepheline–rich and nepheline–poor syenites of the Squaw Lake Alkalic Rock Complex are natrolite, analcite, and stilbite (Trowell 1983). Natrolite, where it is present, may give these rocks a pink to red colour in hand specimen. It occurs as fine–grained locally fibrous, interstitial aggregates. Locally, it is accompanied by carbonate and muscovite and it appears to replace or be intergrown with perthite, perhaps suggestive that nepheline, now represented by natrolite, and potassic feldspar were symplectically intergrown. Stilbite and analcite were identified in thin section and were confirmed by X–ray diffraction analysis by the Geoscience Laboratories, Ontario Geological Survey. They are present in minor amounts and occur similarly to natrolite (Trowell 1976).

Monzonite, Syenomonzonite, Quartz–Bearing Monzonite

Monzonite, quartz–bearing monzonite and syenomozonite (Unit 6g) are dominant in the southern part of the Squaw Lake complex. In hand specimen, the rocks are white to pink in colour on weathered surfaces and pink on fresh surfaces. Megascopically the rocks are fine to medium grained, inequigranular–seriate, and occasionally contain irregularly shaped mafic clots. Miarolitic cavities are rarely present and are usually small, measuring 0.5 to 1.5 cm in longest dimension.

In thin section the rock is fine to medium grained, massive, and inequigranular. The rock is estimated to be composed of 0–20% perthite, 0–50% plagioclase (An 12), 0–20% sericite, 0–13% quartz, 5–10% biotite, 0 to less than 3% calcite, 0–3% chlorite, 0 to less than 1% opaques, with rare sphene and garnet.

The perthite is patchy, anhedral in outline, with irregular rounded grain boundaries. Perthite and subhedral plagioclase (oligoclase) are the major mineral phases within the rock. Sericite is an alteration product after plagioclase. The sericite is fine grained, anhedral and localized within the cores of the plagioclase. Fine–grained quartz is anhedral and interstitial to the feldspar.

Clinopyroxene displays very irregular grain boundaries and is partially altered to biotite and amphibole minerals.

Sphene is brown in colour with a distinctive parting. It occurs as randomly distributed anhedral masses associated with small, euhedral, inclusion–free crystals of garnet.

Fine–grained, anhedral and randomly distributed calcite is interstitial to the feldspars. Biotite occurs in minor amounts as small subhedral grains, occasionally with pleochloric haloes indicative of radioactive zircon inclusions. Fine–grained opaques, primary pyrite and magnetite, are anhedral and disseminated.

Pegmatitic Syenite

A coarser–grained phase of nepheline syenite is pegmatitic (Unit 6h). The pegmatite is buff to brown on both weathered and fresh surfaces. Grain size is very coarse with crystals 3 to 5 cm in size. The pegmatitic syenite is massive, homogeneous and leucocratic. In hand specimen nepheline and potassium feldspar are estimated to comprise 90% of the rock, and biotite 10%.

The pegmatitic syenite is a volumetrically minor phase in comparison with the other varities of syenite. No clear contacts were observed between this phase of syenite and other phases. On the basis of a suggested gradational relationship with the coarse–grained host syenite, the pegmatitic syenite is probably a segregation of the nepheline syenite. It occurs only in a few scattered outcrops in the central and northern portions of the complex.

Hybrid and Hybrid Contact Rocks

A hybrid rock occurs between the mafic metavolcanics and the syenite along the western edge of the complex, and varies in composition from syenodiorite to granite (Unit 6d). Hybrid rocks are massive, fine to medium grained, equigranular and allotriomorphic. They are grey to pink on weathered surfaces and pink on fresh surfaces.

The syenodiorite, on average, is estimated to consist of 45% plagioclase (An14), 40% potassium feldspar, 8% amphibole, 5% sericite, less than 2% clinopyroxene, less than 2% calcite, 1% sphene, and trace amounts of quartz, biotite and opaques.

The plagioclase (An14) and potassium feldspar are subhedral to anhedral with irregular grain boundaries.

Amphibole and biotite occur as alterations after a pale green clinopyroxene. The acicular amphibole is possibly actinolite that locally may contain inclusions of biotite and euhedral sphene. The biotite and amphibole alteration locally encloses uncommon relicts of clinopyroxene.

Sericite is an alteration after plagioclase. Fine–grained calcite occurs interstitial to the various feldspars indicating it crystallized late from the magma or that it is a late stage alteration product of feldspar. Anhedral quartz and opaques are present in trace amounts, intergranular to the feldspar grains.

The granitic variety of hybrid rock is composed mainly of an estimated 50% potassium feldspar, 40% quartz and 10% plagioclase (An12). Biotite, sphene, iddingsite, epidote and amphibole are all present in trace amounts.

Potassium feldspar is fine grained, anhedral, inequigranular–seriate and evenly distributed, as are quartz and plagioclase. Quartz grains occasionally display sutured grain boundaries with each other and are interstitital to the perthite.

The iddingsite occurs as an alteration after olivine which is present in only very minor amounts. Other accessory minerals, sphene and epidote, are randomly distributed. Biotite and amphibole appear to be alterations of pyroxene.

Xenolithic Syenite

An inclusion–rich syenite (Unit 6e) containing xenolithic fragments of syenite and monzonite derived from earlier phases of the complex occurs locally near the perimeter of the Squaw Lake Alkalic Rock Complex. Trowell (1976) described the rock as blocks of quartz–bearing monzonite and syenomonzonite in a syenite matrix. This inclusion syenite is limited to the east and west–central margins of the complex.

A second type of inclusion syenite (Unit 6f) contains primarily mafic metavolcanic fragments similar in appearance to the surrounding country rock. Like other hybrid rocks the wall rock xenoliths in the syenite hybrid phase occur most frequently near the margin of the Squaw Lake complex on the east–central shore of Squaw Lake.

Dike Rocks

Dikes and sills of syenite and monzonite composition (Unit 6j) cut the Squaw Lake complex and may be directly related to the complex. These aplitic to fine–grained dikes are similar in composition to the nepheline–poor syenite and quartz–bearing monzonite. They vary in width from 3 to 45 cm and have variable strikes and dips. The dikes cut all varieties of syenite and mafic metavolcanic host rocks of the Squaw Lake area.

Trowell (1983) described a 1.2 m wide minette–type (biotitic) lamprophyre dike that discordantly intrudes the felsic to intermediate metavolcanics along the western margin of the complex. It contains subrounded 10 to 20 cm diameter inclusions of medium–grained, equigranular metagabbro and medium–grained quartz–feldspar (trondhjemite) porphyry. The relationship of this lamprophyre to the Sturgeon Narrows or Squaw Lake complex is unknown.

PETROLOGY

A suite of rock samples was carefully selected from the Sturgeon Narrows and Squaw Lake Alkalic Rock Complexes and all weathered surfaces, altered fractures and inclusions were removed with a diamond saw. The reported chemical compositions are thus representative of the freshest material available. The normative mineralogy reported has been calculated following the method outlined by Irvine and Baragar (1971). The norms are given here for comparison with other alkalic rock complexes. The Sturgeon Narrows complex and perhaps the Squaw Lake complex likely represent crystal mushes and thus the chemical compositions of rock samples do not reflect liquid trends. Speculation on liquid trends must await microprobe analysis of the primary mineral phases.

Figures 4a and b are AFM plots of compositions of the outer nepheline syenite and syenite. While there is a scatter of data, the data points display a strong tendency to cluster towards the "A" apex. This reflects the high alkali content and moderately low mafic content of these rocks. Comparison of Figures 4a and b indicates no significant chemical difference between nepheline syenite and nepheline–free syenite and this confirms their intimate field association and gradational nature.

With some exceptions, the leucocratic nepheline–rich and nepheline–poor syenites of the core display a moderate to strong tendency to cluster towards the "A" apex of the diagram (Figure 4c, d), reflecting their highly alkalic nature and low mafic content and their general chemical similarity to the outer nepheline syenite and nepheline–free syenite illustrated in Figures 4a and b.

The syenodiorite phases display a moderate to strong clustering in the centre of Figures 4d and e. This more primitive rock composition is also indicated by both field and petrographic study. This rock group clusters at some distance from nepheline–bearing and nepheline–free rocks of the inner and outer syenites indicating a much less evolved, more iron and magnesium-rich petrogenetic system.

Chemical data for the Squaw Lake intrusion is too meagre to establish clustering for the various rock groups (Figure 4f). The total rock suite is comparable

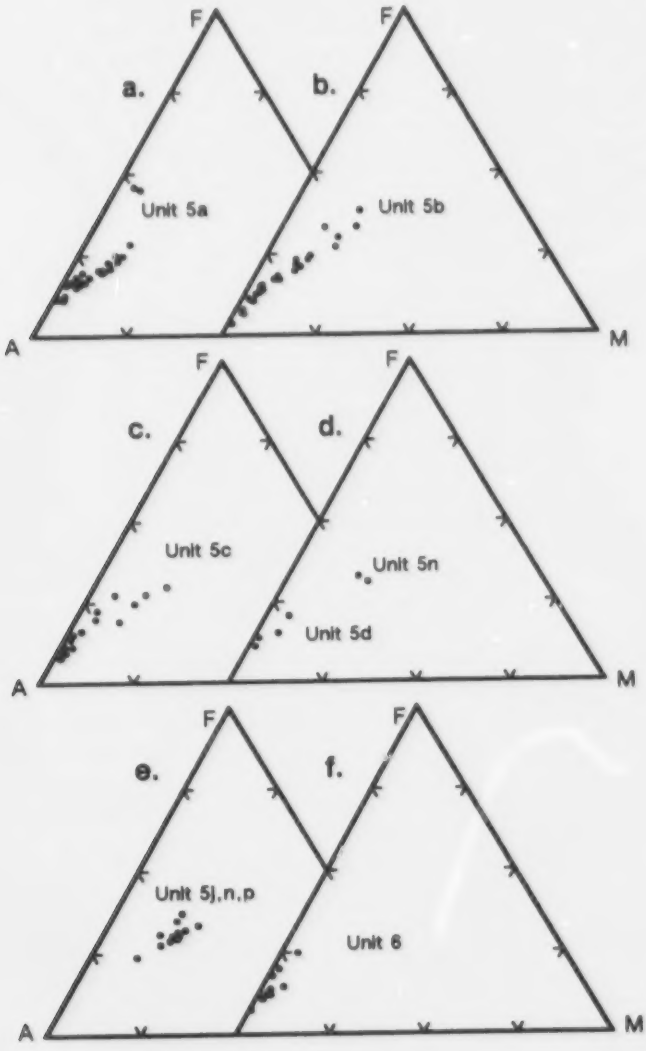

Figure 4. *AFM plot for samples from the Sturgeon Narrows and Squaw Lake Alkalic Rock Complexes. Sturgeon Narrows:* a. *Outer syenite (unit 5a).* b. *Outer nepheline syenite (unit 5b).* c. *Inner nepheline syenite (unit 5c).* d. *Inner syenite (unit 5d) compared with syenodiorite (unit 5n).* e. *Syenodiorite (unit 5j,n,p). Squaw Lake:* f. *Syenite, nepheline syenite, syenodiorite.* $A = Na_2O + K_2O$; $F = FeO_{total}$; $M = MgO$.

with the more alkali–rich rocks of the nepheline–bearing and nepheline–free syenites of the outer and inner zones of the Sturgeon Narrows Alkalic Rock Complex.

With respect to minor elements (*see* Table A–2, Appendix A), both complexes display the typical enrichment in barium and strontium characteristic of the alkalic rock suite (Gerasimovsky 1974). Both phosphorus and titanium appear to be somewhat lower than expected for this rock group. Certainly the values obtained from the Sturgeon Narrows rocks are lower than values obtained by the author from the Poohbah Lake and Wapikopa Lake Alkalic Rock Complexes. Preliminary comparison of minor element chemical data between Early Precambrian alkalic rock complexes suggests considerable variation between intrusions.

METAMORPHISM

On the basis of petrographic examination, the Sturgeon Narrows complex appears to be metamorphosed to a much higher degree than either the Poohbah or Wapikopa Lake complexes which are thought by the author to be roughly equivalent in age. Metamorphism within the Poohbah Lake and Wapikopa Lake complexes is largely an autometamorphic or deuteric feature while the Sturgeon Narrows complex has undergone severe deformation and recrystallization particularly along the west flank. The general lack of euhedral mineral components and the allotriomorphic textures in thin section indicate the Sturgeon Narrows complex has undergone some recrystallization. Well developed igneous textures are preserved in outcrop and thin section in the eastern portions of the complex, east of Sturgeon Narrows.

Bent albite twin lamellae of plagioclase, within several of the least deformed samples, may indicate that a primary protoclastic texture is present that could have formed during emplacement of the complex as a mixture of crystals and liquid. Patch perthite and replacement textures suggestive of autometamorphism and alkali mobility were observed by the author at both Poohbah Lake and Wapikopa Lake and are present at the Sturgeon Narrows Alkalic Rock Complex. This suggests similar deuteric or autometamorphic processes were active within the crystallizing alkalic magma.

Deformation or cataclastic textures are best developed along the west side of the complex. Deformation textures vary from simple protoclastic textures to mylonite. The protoclastic textures are represented by bent albite twin planes, wavy extinction, and weak fracturing of the grains. The mylonites contain rotated, fractured porphyroclasts of feldspar in a fine–grained recrystallized matrix of plagioclase and potassium feldspar. The mylonitic rocks are schistose in appearance on outcrop and may display a weak flow banding characteristic of mylonites. The schistosity is defined by the preferred orientation of the phyllosilicates (biotite and sericite) within the deformed rock. As the degree of deformation increases, mineral grain boundary characteristics change. The rocks that underwent protoclastic deformation display curved grain boundaries and those more strongly deformed display lobate to interdigitating boundaries. The strongly deformed mylonitic rocks generally exhibit curved to lobate grain boundaries and have a granoblastic–elongate texture.

Thin section examination implies that the Sturgeon Lake complex was likely emplaced, at least in part, as a crystal mush which developed a mild protoclastic texture by bending and fracturing the feldspar crystals during emplacement. The complex has subsequently been deformed and recrystallized along the west flank presumably in conjunction with deformation of the Sturgeon Lake supracrustal

rocks. The deformation and recrystallization is a dynamothermal metamorphism related to fault movement along Sturgeon Narrows and is not related to a regional metamorphic event unless deformation and regional metamorphism were coeval. This deformation and metamorphism superimposed secondary textures on the earlier primary textures. Therefore, both primary and secondary fracturing of the feldspars are present and at least locally cannot be separated. The enveloping supracrustal rocks have been metamorphosed to the greenschist facies rank of regional metamorphism (Trowell 1983).

Contact metamorphic – metasomatic effects are discussed above under "Fenitization".

Patch perthite is present within the Squaw Lake intrusive rocks and is interpreted to have formed by potassium replacement of the plagioclase. Stained sections show potassium concentrated along grain boundaries, cleavage planes and fractures within the plagioclase implying potassium mobility that was likely introduced. Plagioclase and potassium feldspars marginal to the larger perthite grains form an interlocking mosaic of crystals. This may be the result of subsolvus crystallization or late stage recrystallization of plagioclase exsolved from perthite.

The Squaw Lake Alkalic Rock Complex has not been significantly affected by regional metamorphism and lacks the deformation and recrystallization textures found in the Sturgeon Narrows Alkalic Rock Complex. Sutured quartz grain boundaries within some thin sections indicate mild recrystallization of the quartz.

Alteration of nepheline to zeolites is attributed to a late stage autometamorphic event at Squaw Lake. At Sturgeon Narrows, the zeolitic alteration of the nepheline is likely both a late–stage autometamorphic feature and a deformation–recrystallization feature related to faulting and recrystallization along its west flank. The syenitic rocks along the west flank of the Sturgeon Narrows complex contain little, if any, fresh nepheline which contrasts with its presence in the eastern portions of the complex.

STRUCTURAL GEOLOGY

The Sturgeon Narrows and Squaw Lake Alkalic Rock Complexes are enclosed within the Sturgeon Lake metasedimentary–metavolcanic belt which lies within the Wabigoon Subprovince of the Superior Province. Trowell (1976, 1983), concluded that the Sturgeon Narrows complex was emplaced along a metavolcanic–metasedimentary contact. On the basis of a cross–cutting aeromagnetic pattern, step–like ridges in the metavolcanics on the west side of Sturgeon Narrows, and cataclastic textures in the syenitic rocks on the east shore of Sturgeon Narrows, Trowell (1976) delineated a major fault or shear zone along the west side of the complex and down the medial line of Sturgeon Narrows. The author observed narrow protomylonite zones with crushed and rotated feldspar crystals up to 1 m in width within the syenite at numerous sites along the east shore of Sturgeon Narrows, and concurs with Trowell's (1976) interpretation.

A second fault zone of minor significance is interpreted to lie at the east end of East Bay of Sturgeon Lake. The presence of this fault is implied from possible offset of the syenodiorite unit across a narrow channel at the end of East Bay.

The immediate contacts of the Sturgeon Narrows Alkalic Rock Complex are generally concordant with the enclosing wall rocks, and trachytoidal textures in the syenite generally conform to the outline of the intrusion (Trowell 1976). The trachytoidal textures resulted from the movement of the crystal mush; the tabular potassium feldspar crystals were oriented parallel or subparallel to each other due

to constraints of flow regime. This texture is best displayed at the periphery of the outer syenite. Extreme deformation within some of the cataclastic zones along the east flank of the complex has locally modified the shape and orientation of some of the feldspar crystals. The first evidence of feldspar breakdown is the appearance of numerous subparallel fractures normal to the long axis of the feldspar crystals. With increasing deformation the feldspars became lensoid, polycrystalline (crushed) aggregates. With the development of mylonite, evidence of former phenocrysts largely disappears and the rock becomes an easily cleavable schist. At this extreme development of cataclastic textures, the former feldspar phenocrysts are discontinuous, wispy streaks on the weathered outcrop surface.

In thin section, the mylonitic rocks are seen to contain porphyroclasts of fractured and rotated feldspar grains displaying wavy extinction in a matrix of recrystallized comminuted feldspars. The schistosity is defined by the preferred orientation of biotite.

Variations in mafic–felsic ratios and grain size define a crude banding or layering in some outcrops. This banding trends parallel to the planar feature defined by the trachytoidal texture. In general, banding is not sufficiently well developed or widespread to be of value in determining the emplacement history of the complex.

Deformation and metamorphism within the Sturgeon Narrows complex are likely to have taken place concomitantly with the deformation and folding of the supracrustal rocks which it intrudes, however, field evidence supporting this interpretation is lacking.

The sequence of emplacement of the various phases is unknown as outcrops displaying the needed contact relationships were not found. The author suggests that the more mafic syenodiorite phase may be the older because it represents a melt composition that appears more primitive than the other two.

The Sturgeon Narrows intrusion may be exposed at a moderately high level. The presence of miarolitic cavities within the pegmatitic segregations of the coarse–grained phases, rare interstitial granophyre and xenolith bearing margins imply that the body is exposed at a relatively high level. The xenolithic margins also suggest that the magma caused a limited amount of stoping during emplacement. The author concurs with Trowell (1983) that the complex is hypabyssal in character.

The Squaw Lake intrusion is conformable with the enclosing metavolcanics and metasediments and trachytoidal textures within the alkalic rocks are tangential to the margins of the pluton (Trowell 1976).

Some local variations in composition and texture define a crude layering in the Squaw Lake complex. Sketchy lithologic data suggests that the complex may be zoned or composite in nature.

Evidence for protoclastic textures is common within the Squaw Lake complex and consists of fracturing of the feldspar grains, bending of the twin planes in feldspars, kinking of cleavage planes in biotite, and porphyroclasts of feldspar set in a recrystallized comminuted matrix. The deformation textures appear similar to the Sturgeon Narrows complex. Deformation may have occurred at the same time as folding and metamorphism of the enclosing supracrustal rocks.

GEOCHRONOLOGY

Bell *et al.* (1979) made the first attempt to isotopically date the Sturgeon Narrows Alkalic Rock Complex. They obtained a value of 2400 ± 100 Ma with an

$^{87}Sr/^{86}Sr$ ratio of 0.7014 ± 0.0008. The age was considered to be preliminary and the strontium isotopic ratio indicates slight crustal involvement (Bell *et al.* 1979).

Kwon (1986) completed additional isotopic studies on the Sturgeon Narrows Alkalic Rock Complex in the U–Th–Pb, Rb–Sr and Sm–Nd systems. A Pb–Pb isochron gave an age of 2686 ± 14 Ma which Kwon (1986, p.76) indicated to be controlled by sphene data. A Pb–Pb isochron age of 2671 ± 31 Ma was obtained neglecting sphene data and Kwon (1986, p.76) prefers this age. Kwon reported that one sample WST18–8A (reference number 739) gave an internal Pb–Pb isochron age of 2691 ± 26 Ma. Kwon (1986, p.76, 77) presented other dates on other samples and on leachate, all of which are Archean and in proximity to the ones cited above.

The Sm–Nd data gave an isochron age of 2500 ± 170 Ma and an internal Sm–Nd isochron age on sample WST18–8A (reference number 739) gave an age of 2746 ± 58 Ma (Kwon 1986, p.78). Using three rocks (WST18–8A, WST25–25, STR19–8, reference numbers 739, 763, 722), Kwon (1986, p.78) obtained an isochron age of 2223 ± 1 Ma which was interpreted to be a mixing line resulting from Nd isotopically heterogeneous magma.

In the Rb–Sr system Kwon (1986, p.78) obtained an age of 2598 ± 12 Ma which is much older than the one reported by Bell *et al.* (1979). Kwon (1986, p.78) considered the age provisional due to the limited number of samples. The initial $^{87}Sr/^{86}Sr$ ratio of 0.70164 was interpreted by him to be slightly enriched suggesting slight crustal influences or mantle heterogeneity (Kwon 1986, p.79).

RECOMMENDATIONS FOR FUTURE STUDY

The present investigation was completed to gain a basic knowledge of the mineralogy and chemistry of the Sturgeon Narrows and Squaw Lake Alkalic Rock Complexes and to provide data for comparison with younger complexes. Examination of all outcrop was impossible within the limited time available.

To develop petrogenetic models for the complexes, additional petrographic work using universal stage and microprobe are needed to better define the mineralogy and compositional variations.

Much more detailed work is needed along the contacts of the complexes to better define the physical and chemical conditions of the metamorphic–metasomatic aureole enveloping the complexes. Assuming that the complex was emplaced prior to deformation and metamorphism of the enclosing supracrustal rocks, regional greenschist metamorphism should have overprinted any existing contact metmorphic aureole. Study of this contact aureole would be best done on Coveney Island or along the eastern contact where deformation and associated dynamothermal metamorphism is not as intense as that on the west side.

A U–Pb isotopic age determination for this complex is desirable.

Economic Geology

Little if any exploration work has been done on the Sturgeon Narrows Alkalic Rock Complex. Various companies have conducted exploration programs covering the marginal area of the intrusion and tested anomalies by diamond drilling in the metavolcanics and metasediments marginal to the complex (Trowell 1976).

Rogers (1964, p.30) detected radioactivity in proximity to Sturgeon Narrows within the Sturgeon Narrows complex. This radioactivity was confirmed by Trowell (1976) and the author made no attempt to evaluate it a third time. Rogers (1964, p.46) described the occurrence as follows:

"No occurrences containing economic amounts of uranium were located. Samples of highly altered, radioactive contact rocks from the Sturgeon Lake syenite gave on analysis a U_3O_8 equivalent of 0.001–0.06 percent. Some of these samples of the radioactive contact rocks contain detectable amounts of thorium, cerium, and lanthanum.

"Two of the samples containing 0.01 and 0.06 percent U_3O_8 equivalent also contain about 0.01 and 0.05 percent niobium, respectively. Although these values are low, the author [Rogers] believes they are significant enough to warrant detailed prospecting along the contacts of the Sturgeon Lake syenite.

"All samples of the Sturgeon Lake syenite and associated contact rocks were also tested by qualitative spectographic analysis for the presence of beryllium. Only trace amounts (less than 0.005%) were found."

The author noted zircon crystals up to 3 mm in pegmatitic phases of the syenite along the west side of the complex near Sturgeon Narrows and noted disseminated zircons in biotite with prominent haloes resulting from radioactive bombardment in a number of thin sections. The author suspects that some of the anomalous radioactivity reported by Rogers (1964) and confirmed by Trowell (1976) is likely due to the presence of radioactive elements in zircon.

A number of carbonate veins were noted by the author. Trowell (1976) sampled a number of these dikes and had them examined spectographically at the Geoscience Laboratories, Ontario Geological Survey, particularly for barium and strontium. The dikes are principally dolomite and do not contain barium and strontium in quantities typical of carbonatites (*see* Heinrich 1966, p.225–228 for typical values). The author examined several of these veins and did not observe a mineral suite or texture characteristic of carbonatites. Trowell (1976) related these veins to fault movements and fracturing associated with faulting along Sturgeon Narrows. The breccia zones and shear zones also contain abundant carbonate. The author is in agreement with Trowell (1976) that these carbonate dikes are not carbonatitic and the author would interpret them as late hydrothermal fracture fillings probably unrelated to the Sturgeon Narrows complex.

Trace amounts of pyrite occur in shear zones, breccias, and fractures within the complex but minerals of potential economic interest were not observed. Pyrite rarely approaches an estimated 3 or 4% and generally consists of euhedral crystals smaller than 1 mm.

Nepheline is too altered on the west side of the complex to have any commercial value. Several outcrops of nepheline syenite on the east side of the complex appear fresh in outcrop and thin section. The east side of the complex would be the most promising for the location of unaltered nepheline syenite, however thin sections indicate that the nepheline contains abundant subparallel inclusions which might render any nepheline concentrate valueless. The inclusions may constitute approximately 20% of a nepheline grain.

Fluorite occcurs as disseminated grains throughout the complex and Trowell (1976, 1983) reported up to 0.5–1% fluorite in carbonate shear zones. The fluorite appears to have little economic potential.

Concentrations of apatite were not observed within the complex and thin section examination indicates apatite to be only a minor accessory phase. The complex has little potential as a source of phosphorus.

Table 3 is a summary of exploration work filed with the Assessment Files Research Office, Ontario Geological Survey. There is no recorded exploration work on the Squaw Lake complex. For additional information on exploration in proximity to the Sturgeon Narrows and Squaw Lake complexes the reader should refer to Trowell (1976). Minerals of potential economic interest were not observed by the field party at Squaw Lake. The generally more silica–saturated nature of this body would limit its potential as a source for economic minerals commonly associated with more silica under–saturated alkalic rock suites.

PROPERTY DESCRIPTIONS

CONWEST EXPLORATION COMPANY LIMITED [1971–1972]

In 1971 and 1972, Conwest Exploration Company Limited completed airborne electromagnetic and magnetic surveys which covered the central and southern portions of the Sturgeon Narrows complex. The company conducted no follow–up work over the Sturgeon Narrows Alkalic Rock Complex.

FALCONBRIDGE NICKEL MINES LIMITED [1974]

In 1974 Falconbridge Nickel Mines Limited completed two diamond drill holes totalling 182 m on the west side of Sturgeon Narrows. This drilling encountered lapilli tuff, agglomerate, and andesite diked by syenite. Trace to 4% disseminated pyrite was reported.

TABLE 3. LIST OF PROPERTIES AND ASSESSMENT WORK IN PROXIMITY TO THE STURGEON NARROWS COMPLEX. (ASSESSMENT FILES RESEARCH OFFICE, ONTARIO GEOLOGICAL SURVEY).

Company Name	Date of Work	File
Conwest Exploration Co. Ltd.	1971, 1972	2.500, 2.685
Greenpoint Mines Ltd. and Consolidated Red Poplar Mines Ltd.	1971, 1972	2.766, 2.426 63.2729, Rept. 19
Falconbridge Nickel Mines Ltd.	1974	Rept. 66
Texmont and Sturdy Mines Ltd.	1971	2.382, 62.2952, 2.180, 2.1091, Rept. 57, 58, 59
W.G. Wahl Ltd.	1969	63.2437, Rept. 10 & 11

GREENPOINT MINES LIMITED — CONSOLIDATED RED POPLAR MINES LIMITED [1971–1972]

In 1971, Greenpoint Mines Limited and Consolidated Red Poplar Mines Limited held a group of 58 unsurveyed claims over and east and west of the northern end of Sturgeon Narrows.

In 1970, airborne magnetic and electromagnetic surveys were carried out over the property, and in 1971, these were followed by ground magnetic and electromagnetic surveys.

In 1971, six diamond drillholes with a total length of 521.8 m were drilled west of Sturgeon Narrows (Assessment Files Research Office, Ontario Geological Survey, Toronto). A mixed assemblage of mafic to intermediate and felsic to intermediate metavolcanics was reported by the company from the drilling. Local sulphide sections consisting of pyrite and pyrrhotite and traces of chalcopyrite were also reported from the drilling.

In 1971, four diamond drillholes with a total length of 169 m were drilled on the east side of Sturgeon Narrows south of Anderson Lake (Assessment Files Research Office, Ontario Geological Survey, Toronto). The diamond drillholes were reported by the company to have intersected mainly metasediments, hornfelsed metasediments, skarn, and tactite, indicating that the metasedimentary units perhaps extend further west than interpreted by Trowell (1976).

In 1972, the company completed an additional 9 diamond drill holes into this zone totalling 472 m. This drilling encountered disseminated and massive pyrite and pyrrhotite with minor chalcopyrite. The drill–tested sulphide zone is reported to contain some graphite and to have a strike length in excess of 120 m.

The property is underlain on the west side of Sturgeon Narrows by an intercalated assemblage of mafic to intermediate and felsic metavolcanics, and minor metasediments, and is cut by minor mafic intrusive rocks. The eastern portion of the property is underlain by a portion of the Sturgeon Narrows Alkalic Rock Complex and its fenitized contact zone which is dominantly a metasedimentary assemblage.

TEXMONT MINES LIMITED — STURDY MINES LIMITED [1972]

In 1970, ground magnetic and electromagnetic surveys were conducted over a claim group east of Seaton Island. In 1971, airborne magnetic and electromagnetic surveys were completed over the property. The property is underlain by mafic to intermediate metavolcanics and intercalated metasediments which have been intruded by the Sturgeon Narrows Alkalic Rock Complex and by ultramafic (serpentinized peridotite) intrusive rocks.

In 1972 the company completed additional ground magnetometer and electromagnetic surveys and drilled four diamond drillholes totalling 487.5 m. Two holes totalling 217.5 m were drilled close to the syenite–metavolcanic contact at the south end of the Sturgeon Narrows complex. The drill logs indicate that pyrite in quantities of 8–25% with traces of chalcopyrite is present in one hole over a core length of 33.2 m. The rock types reported by the company are rhyolitic tuff, carbonatized breccia, dacitic amygdaloidal lava, volcanic agglomerate, and pyroxenite.

W.G. WAHL LIMITED [1969]

In 1968, ground magnetic surveys were completed by W.G. Wahl Limited over a group of claims on the west side of Sturgeon Narrows.

In 1969, five diamond drillholes, with a total length of 1322 m were drilled (Assessment Files Research Office, Ontario Geological Survey, Toronto). Subsequently, in 1970, Selco Exploration Company Limited drilled two holes for a total length of 443.5 m on the property (Assessment Files Research Office, Ontario Geological Survey, Toronto).

The five drillholes of 1969 intersected rock units of the Sturgeon Narrows Alkalic Rock Complex and a mixed assemblage of intermediate metavolcanics and metasediments intruded by the complex. Fluorite mineralization, minor strontianite (strontium carbonate) and roscoelite (vanadium mica) were reported by the company (Assessment Files Research Office, Ontario Geological Survey, Toronto). Sulphides and local anomalous gold values were also reported. Mylonite zones intersected by the drilling were interpreted by Wahl as the result of block faulting bordering a graben structure extending down Sturgeon Narrows. The two drillholes of 1970 were reported by the company to have intersected a mixed assemblage of felsic to intermediate pyroclastic rocks, argillaceous metasediments and graphitic tuff ± pyrite zones.

The property is underlain by an assemblage of metasediments and some intermixed pyroclastic rocks which have all been intruded and subsequently fenitized by the Sturgeon Narrows Alkalic Rock Complex. Disseminated fluorite mineralization occurs in the alkalic rocks. Locally sheared and carbonatized zones contain more massive pods of fluorite.

RECOMMENDATIONS TO THE PROSPECTOR

The Sturgeon Narrows Alkalic Rock Complex has been covered by airborne electromagnetic and magnetic surveys without disclosing anything of interest. Mapping by Trowell (1976, 1983), and by the author has disclosed barren sulphides in only trace to minor quantities. The fluorite veins or fracture fillings in the Sturgeon Narrows complex are narrow and short. Apatite in rocks of the complex is usually present in amounts less than 1%. The nepheline is highly altered along the western side of the body. Nepheline is much fresher in the eastern half of the body but it is also slightly altered. Although it is possible that a zone of nepheline syenite of potential economic interest may exist in the eastern part of the intrusion, the chances are not as good as in other alkalic rock plutons. Those seeking economic mineral deposits in the area of the Sturgeon Narrows complex would best concentrate on the enveloping metasediments and metavolcanics.

The Squaw Lake intrusion is largely covered by the waters of Squaw Lake preventing an assessment of its true economic potential. It would tentatively appear that the same critique that applies to the Sturgeon Narrows complex (with the exception of nepheline) would also apply to the Squaw Lake complex. The nepheline content of the Squaw Lake intrusion appears to be much less than that of the Sturgeon Narrows complex and it is thus of more limited economic interest.

Appendix A — Petrographic Descriptions, Chemical Analyses, Normative Compositions and Statistical Compositions of Lithologic Units of the Sturgeon Narrows and Squaw Lake Alkalic Rock Complexes.

TABLE A-1. PETROGRAPHIC AND FIELD DESCRIPTIONS OF WHOLE-ROCK SAMPLES* FROM THE STURGEON NARROWS AND SQUAW LAKE ALKALIC ROCK COMPLEXES.

Reference No. 665
Sample No. STR2-15

Nepheline syenite.

Field Description. Medium to coarse grained, massive, inequigranular-seriate. Nepheline is altered to a pale green colour. Weathered and fresh surfaces are mottled pale green and bluish grey. Map unit 5a.

Petrographic Description. Fine to coarse grained, massive, inequigranular-seriate, allotriomorphic with curved to straight grain boundaries. Sericite forms fine-grained mats interstitial to perthite. Perthite is a patch perthite. Plagioclase (An42) forms irregular, fine-grained, interstitial aggregates. Sericite is possibly after former nepheline.

Reference No. 666
Sample No. STR2-18

Cancrinite syenite.

Field Description. Medium to coarse grained, massive, inequigranular-seriate. Nepheline is weathered chalky white and weathered surfaces are deeply pitted. Colour index is approximately 20%. Weathered and fresh surfaces are mottled white, bluish grey, and black. Map unit 5a.

Petrographic Description. Fine to coarse grained, inequigranular-seriate, allotriomorphic, cataclastic. Pyroxene occurs as small, irregular, dark brown grains in trace amounts. Cancrinite forms fine grained, interstitial, elongate aggregates. Fluorite occurs as dark purple, interstitial grains. Perthite is a patch perthite with ragged edges and irregular fractures.

Reference No. 667
Sample No. STR2-30

Syenodiorite.

Field Description. Medium grained, massive, equigranular. Weathered surfaces are buff and black, fresh surfaces mottled with pink and black. Colour index aporoximately 40%. Map unit 5j.

Petrographic Description. Fine to coarse grained, massive, inequigranular-seriate, allotriomorphic with curved grain boundaries. Patch perthite forms irregular grains. Pyroxene forms colourless, irregular grains with rusty brown edges. Amphibole forms dark brown, irregular grains associated with biotite, possibly after pyroxene. Potassium feldspar forms irregular, interstitial grains.

Reference No. 668
Sample No. STR2-31

Cancrinite syenite.

Field Description. Medium to coarse grained, inequigranular-seriate, weakly trachytoidal. One end of the outcrop is sheared. Colour index approximately 20%. Weathered and fresh surfaces are mottled pinkish grey, buff and black. Map unit 5a.

Petrographic Description. Fine to coarse grained, massive, inequigranular-seriate, allotriomorphic with curved grain boundaries. Patch perthite forms irregular grains and grades into cryp-

*Reference numbers for outcrop samples are plotted on Figure 3 (Chart A).

toperthite. Biotite forms irregular grains with bent (001) planes. A broken amphibole (?) crystal is dark brown in colour. Sericite, zeolite, and cancrinite are possibly after nepheline. Potassium stain indicates potassium along fractures and grain boundaries.

Reference No. 669
Sample No. STR2-35

Nepheline syenite.

Field Description. Coarse grained, inequigranular-seriate, weakly trachytoidal. Colour index approximately 20%. Former nepheline is altered to a chalky white. Weathered surface and fresh surfaces are mottled white, bluish grey and black. Map unit 5a.

Petrographic Description. Fine to coarse grained, massive, inequigranular-seriate, allotriomorphic with curved to ragged grain boundaries. Cryptoperthite forms irregular large grains with zones of fine-grained plagioclase. Biotite forms irregular clots with ragged edges and bent cleavage planes. Calcite and fluorite are interstitial. Very fine-grained saussurite after nepheline is interstitial to feldspars. Potassium staining indicates potassium concentrated along fractures and grain boundaries. Cryptoperthite shows some fracturing and rehealing by very fine-grained plagioclase.

Reference No. 670
Sample No. STR2-36

Biotite syenite.

Field Description. Medium to coarse grained, inequigranular-seriate, weakly trachytoidal. Colour index approximately 20%. Weathered and fresh surfaces are mottled bluish grey and black. Map unit 5a.

Petrographic Description. Fine to coarse grained, inequigranular, seriate, allotriomorphic, cataclastic. Biotite forms brown bent books in association with a turbid, unidentified, brown mineral. This mafic component is an alteration of the primary mafic minerals. Perthite forms large irregular crushed grains with undulatory extinction. Some recrystallization is evident along grain borders and in cracks traversing the grains. Minor interstitial calcite is present.

Reference No. 671
Sample No. STR4-1

Cancrinite syenite.

Field Description. Medium to coarse grained, inequigranular-seriate, weakly trachytoidal. Colour index approximately 15%. Weathered and fresh surfaces are mottled bluish grey and black. Map unit 5a.

Petrographic Description. Fine to coarse grained, protoclastic, inequigranular-seriate, allotriomorphic with curved grain boundaries. Biotite forms irregular grains with bent cleavage planes. Calcite and cancrinite after nepheline are very fine grained. Perthite is a cryptoperthite with numerous healed fractures containing calcite and very fine-grained plagioclase(?).

Reference No. 672
Sample No. STR4-3

Nepheline syenite.

Field Description. Medium to coarse grained, inequigranular-seriate, weakly trachytoidal. Nepheline weathers white. Colour index approximately 15%. Weathered surfaces are mottled white, bluish grey and black and are deeply pitted. Map unit 5a.

Petrographic Description. Fine to coarse grained, massive, inequigranular-seriate, allotriomorphic, cataclastic. The rock is deformed and broken up. Biotite forms fine-grained elongate mats. Cryptoperthite forms irregular, ragged, fractured grains. Calcite and sericite form large irregular masses after nepheline and fill fractures in feldspars.

Reference No. 673
Sample No. STR4-10

Cancrinite syenite.

Field Description. Medium to coarse grained, inequigranular-seriate, weakly cataclastic, weakly trachytoidal. Colour index approximately 10%. Some altered nepheline is present. Weathered and fresh surfaces are bluish grey with black and white flecks. Map unit 5a.

Petrographic Description. Fine to coarse grained, inequigranular-seriate, allotriomorphic, cataclastic. Biotite forms irregular, fine-grained, elongated, ragged mats. Cancrinite is fine grained, and forms elongated clots between feldspar grains. Traces of euhedral sphene have a parting. Perthite forms broken, irregular grains, locally with faint development of string perthite. It has wavy extinction.

Reference No. 674
Sample No. STR4-12

Nepheline (?) syenite.

Field Description. Medium grained, equigranular, massive. Colour index 35%. Weathered surfaces are white to buff with faint reddish spotting, and deeply pitted. Fresh surfaces are mottled bluish grey and black. Map unit 5b.

Petrographic Description. Medium grained, equigranular, massive, hypidiomorphic. Nepheline is altered to sericite. Amphibole is dark brown, possibly hedenbergite. Amphibole occurs after pyroxene and may contain some biotite flakes. Pyroxene is clear, colourless, and forms subhedral to anhedral grains with inclusions of apatite. Biotite forms irregular masses and ragged grains, locally in clusters of crystals or enclosed in amphibole.

Reference No. 675
Sample No. STR4-13B

Mylonitized nepheline (?) syenite.

Field Description. Medium to coarse grained, inequigranular-seriate, massive, with some cataclastic textures. Colour index approximately 10%. Weathered and fresh surfaces are mottled bluish grey and streaky black. Map unit 5b.

Petrographic Description. Fine to medium grained, inequigranular-seriate, foliated, allotriomorphic, protomylonite. Biotite forms fine-grained, discontinuous, wispy, elongate aggregates that define a foliation. Feldspars consist of large fractured phenoclasts set in a fine-grained, recrystallized groundmass of the same.

Reference No. 676
Sample No. STR4-13C

Nepheline syenite.

Field Description. Medium grained, massive, equigranular. Colour index 35 to 40%. Weathered and fresh surfaces are mottled pinkish grey and black. The sample is from a dike cutting the coarser grained syenite and appears similar in composition. Map unit 5a.

Petrographic Description. Fine to medium grained, inequigranular-seriate, massive, hypidiomorphic. Pyroxene forms euhedral to subhedral grains with poikilitic apatite. Amphibole forms irregular grains, at least in part replacing pyroxene and enclosing biotite. Biotite is after amphibole and, in part, enclosed within amphibole. Perthite forms an interlocking mosaic of anhedral grains. Nepheline is altered to sericite and cancrinite. Trace of myrmekite is present.

Reference No. 677
Sample No. STR4-20

Cancrinite syenite.

Field Description. Medium to coarse grained, inequigranular-seriate, weakly trachytoidal. Weathered surfaces are pitted and nepheline weathers grey. Weathered surfaces are mottled grey, bluish grey and black; fresh surfaces are bluish grey and black. Map unit 5a.

Petrographic Description. Fine to coarse grained, massive, inequigranular-seriate, allotriomorphic with curved to straight grain boundaries. Biotite forms fine-grained mats; larger grains are slightly bent. Plagioclase (An2-10)? forms tiny interstitial grains marginal to the larger grains of cryptoperthite. Perthite has wavy extinction. Cancrinite forms small interstitial grains, probably after nepheline.

Reference No. 678
Sample No. STR4-23

Cancrinite-sodalite syenite.

Field Description. Medium grained, massive, possibly weakly cataclastic, inequigranular, seriate. Weathered surfaces are pitted and nepheline weathers buff. Colour index approximately 10%. Weathered surfaces are bluish grey, fresh surfaces buff with black flecks. Map unit 5a.

Petrographic Description. Fine to coarse grained, inequigranular, seriate, allotriomorphic with embayed to interdigitating grain boundaries. Pyroxene is altered, forms a turbid, brownish, irregular mass with relict pyroxene cleavage. Needles of actinolite are present throughout the thin section. Perthite forms irregular ragged grains enclosed in a finer grained matrix of the same material. Some perthite is patchy but most is cryptoperthite. Cancrinite and sodalite are interstitial to feldspars.

Reference No. 679
Sample No. STR11-7A

Cancrinite syenite.

Field Description. Medium to coarse grained, inequigranular-seriate, weakly trachytoidal. Colour index approximately 20%. There are nepheline syenite pegmatitic segregations in the outcrop. Weathered and fresh surfaces are mottled bluish grey and black. Some medium-grained syenite of similar composition may be xenolithic in the coarse-grained phase. Map unit 5a.

Petrographic Description. Fine to coarse grained, inequigranular-seriate, allotriomorphic with curved grain boundaries. Cancrinite forms large to small polycrystalline aggregates. Sodalite and myrmekite are interstitial to the feldspars. Biotite forms fine-grained aggregates, possibly after mafic minerals. Plagioclase (An40) forms large grains undergoing patchy replacement. Microcline forms anhedral grains, several with tiny random plagioclase feldspar inclusions.

Reference No. 680
Sample No. STR11-8A

Cancrinite syenite.

Field Description. Medium to coarse grained, inequigranular-seriate, trachytoidal, weakly cataclastic. Colour index approximately 10%. Weathered surfaces are pitted and nepheline weathers grey-buff. The outcrop contains a nepheline pegmatite segregation and is locally cut by medium-grained phase of similar composition. Weathered and fresh surfaces are grey flecked with black. Map unit 5a.

Petrographic Description. Fine to coarse grained, inequigranular-seriate, allotriomorphic with curved to lobate grain boundaries. Plagioclase (An40?) is anhedral, forming interstitial grains between microclines. Microcline forms large fractured grains. Biotite forms ragged grains with some bending of cleavage planes. Cancrinite forms a mosaic of grains interstitial to feldspar. Epidote forms ragged, irregular grains possibly after pyroxene. Microcline is fractured and the rock is in part cataclastic.

Reference No. 681
Sample No. STR11-8B

Sodalite syenite.

Field Description. Medium to coarse grained, massive, inequigranular-seriate. Weathered surfaces are pitted and altered nepheline weathers grey. Weathered and fresh surfaces are mottled grey, bluish grey and black. Rock lacks evidence of cataclastic textures found in sample STR11-8A. Map unit 5a.

Petrographic Description. Fine to coarse grained, protoclastic, inequigranular-seriate, allotriomorphic, straight to curved grain boundaries. Chlorite and epidote with minor biotite are after former mafic components. Plagioclase (An40) forms anhedral, irregular grains marginal to the perthite grains. Microcline perthite forms anhedral, irregular grains with undulatory extinction; the grains are fractured and have undulatory extinction. Sodalite is interstitial.

Reference No. 682
Sample No. STR11-9

Nepheline syenite.

Field Description. Medium to coarse grained, trachytoidal, inequigranular-seriate. Some carbonate is present. Colour index 20%. Weathered and fresh surfaces are bluish grey and black. Map unit 5a.

Petrographic Description. Fine to coarse grained, massive, inequigranular-seriate, allotriomorphic with curved grain boundaries. Dark brown garnet forms interdigitating lobate masses with biotite. Biotite also forms discrete grains. Microcline perthite forms anhedral grains with well developed quadrille twinning. Nepheline is moderately altered to sericite and is interstitial. Plagioclase (An4) grains with weak protoclastic texture form interlocking mosaics.

Reference No. 683
Sample No. STR11-11

Cancrinite syenite.

Field Description. Medium to coarse grained, trachytoidal, inequigranular-seriate. Colour index approximately 20%. Weathered surfaces are pitted and altered nepheline has a pinkish buff colour. Weathered and fresh surfaces are mottled black, bluish grey and pinkish buff. Map unit 5a.

Petrographic Description. Fine to coarse grained, inequigranular-seriate, allotriomorphic with curved to interdigitating grain boundaries. Some recrystallization is evident along grain boundaries. Amphibole is pale green and generally ragged in outline. Garnet is anhedral to euhedral. Nepheline is very fine-grained and altered to sericite (?). Cancrinite forms irregular grains and aggregates interstitial to feldspars. Biotite occurs as irregular rounded grains. Microcline perthite forms an interlocking mosaic. Perthite is generally p: tchy.

Reference No. 684
Sample No. STR11-15B

Nepheline syenite.

Field Description. Medium to coarse grained, massive, inequigranular-seriate. Weathered surface pitted and altered nepheline weathers pinkish. Weathered and fresh surfaces are mottled pinkish, bluish grey and black. Colour index 15%. Map unit 5a.

Petrographic Description. Fine to coarse grained, massive, inequigranular-seriate, allotriomorphic with curved to interdigitating grain boundaries. Sphene forms wedge shaped crystals. Amphibole forms dark brown, anhedral grains with ragged edges and shows some alteration to biotite. Minor interstitial sodalite is present. Garnet and biotite forms intermixed grains with lobate grain boundaries, probably after amphibole. Larger ragged grains of biotite are after amphibole. Cancrinite is a minor interstitial phase. Nepheline is altered to fine-grained sericite(?). Microcline is a perthite, forming anhedral grains with stringy texture and wavy extinction.

Reference No. 685
Sample No. STR11-16C

Sodalite cancrinite syenite.

Field Description. Medium to coarse grained, inequigranular-seriate. Weathered surfaces are pitted and altered nepheline is pinkish purple. Colour index approximately 15%. Fresh and weathered surfaces are mottled pinkish grey and black. Map unit 5a.

Petrographic Description. Fine to coarse grained, massive, inequigranular-seriate, allotriomorphic with curved grain boundaries. Epidote and biotite form fine-grained, polycrystalline aggregates, possibly after amphibole. Sodalite is interstitial, clear, and sometimes associated with fluorite. Amphibole is dark brown, largely relict, and altering to biotite and epidote. Myrmekite along margins of some larger microcline grains has stringy texture and wavy extinction. Plagioclase forms fine-grained, polycrystalline mosaics between larger microcline grains and large plagioclase grains with protoclastic texture and patchy replacement. Cancrinite forms polycrystalline aggregates between larger feldspar grains. Minor euhedral sphene is present.

Reference No. 686
Sample No. STR11-19A

Sodalite syenite.

Field Description. Medium to coarse grained, trachytoidal, inequigranular-seriate. Rock appears to be slightly cataclastic. Rock is leucocratic with colour index less than 10%. Outcrop locally has pegmatitic segregations with up to 30% altered nepheline. The outcrop includes a large xenolithic block of mafic metavolcanics. Map unit 5a.

Petrographic Description. Fine to coarse grained, inequigranular-seriate, allotriomorphic with curved to st[illegible]ght grain boundaries. Biotite and epidote forms polycrystalline aggregates after amphibole(?). Plagioclase (An40) displays good protoclastic textures and has patchy replacement. It occurs as intergranular twinned and untwinned grains and as large grains. Microcline forms anhedral, irregular grains with wavy extinction and stringy texture. Sodalite forms clear interstitial grains.

Reference No. 687
Sample No. STR16-2

Leucocratic cancrinite syenite.

Field Description. Medium to coarse grained, inequigranular-seriate. Weathered surfaces are pitted and altered nepheline is buff to pinkish white. Grain size locally coarsens to pegmatitic.

Colour index approximately 10%. Weathered and fresh surfaces are mottled pink and buff with scattered black specks. Map unit 5b.

Petrographic Description. Very fine to coarse grained, inequigranular–seriate, allotriomorphic with curved to interdigitating grain boundaries. Plagioclase (An33–36) forms anhedral, irregular grains filling interstices between microcline grains. Cancrinite forms irregular, interstitial grains. Scapolite forms ragged, prismatic grains. Microcline perthite forms anhedral, irregular grains, sometimes with wavy extinction.

Reference No. 688
Sample No. STR16–3

Leucocratic syenite.

Field Description. Medium to almost coarse grained, inequigranular–seriate. Some coarse grained nepheline–bearing pegmatitic segregations are present. Colour index approximately 10%. Weathered and fresh surfaces are mottled pink with black spots. Map unit 5b.

Petrographic Description. Fine to coarse grained, inequigranular–seriate, allotriomorphic with curved to interdigitating grain boundaries. Dark reddish brown alteration of an unidentified mafic mineral. Plagioclase (An30–36) forms twinned and untwinned interlocking mosaics enclosing larger perthite grains. Microcline perthite forms irregular grains with anhedral outline and both stringy and patch perthite textures. Some plagioclase shows patch perthite replacement.

Reference No. 689
Sample No. STR16–6B

Nepheline (?) bearing syenite.

Field Description. Medium grained, massive, equigranular. Colour index less than 5%. The outcrop contains elongated mafic volcanic inclusions. Locally the outcrop is coarse grained and pegmatitic. Weathered and fresh surfaces are pinkish grey. Map unit 5a.

Petrographic Description. Fine to medium grained, equigranular, massive, allotriomorphic with curved to interdigitating grain boundaries. Scapolite forms prismatic fibres with moderate relief, and possibly replaces pyroxene. Plagioclase (An13?) forms part of an anhedral, interlocking mosaic with microcline. Some grains are a patchy perthite replacement of plagioclase. Some zeolite (?) is after nepheline(?).

Reference No. 690
Sample No. STR16–8

Garnet, aegirine–augite syenite.

Field Description. Medium to coarse grained, massive, inequigranular–seriate. Colour index 20–25%. Weathered and fresh surfaces are mottled pink and black. Pegmatitic segregations with altered nepheline are common on outcrop. Map unit 5a.

Petrographic Description. Fine to coarse grained, massive, inequigranular, allotriomorphic with curved grain boundaries. Subhedral to anhedral grains of aegirine–augite pyroxene are dark brown. Cores of larger grains are slightly paler in colour than smaller grains. Garnet forms dark brown, euhedral to subhedral grains in association with pyroxene. Garnet is probably melanite. Minor interstitial nepheline is present. Plagioclase forms a mosaic of interlocking grains enclosing microcline perthite. Microcline perthite forms anhedral, irregular grains.

Reference No. 691
Sample No. STR16–13

Cancrinite syenite.

Field Description. Medium to coarse grained, inequigranular–seriate, weakly trachytoidal. Weathered surfaces are pitted and nepheline is altered to yellowish brown. Colour index approximately 15%. Weathered and fresh surfaces are mottled yellow–brown, bluish grey and black. Map unit 5b.

Petrographic Description. Fine to coarse grained, inequigranular–seriate, allotriomorphic, cataclastic. Larger microcline grains appear to be porphyroclasts set in a recrystallized matrix. Cancrinite forms large, clear, composite grains. Biotite forms large books, some with wavy extinction and bent cleavages. Plagioclase (An3–7) forms interlocking mosaics enclosing larger perthite grains. These mosaics may represent recrystallized crushed zones. Microcline forms irregular anhedral grains. Some patch perthite is present, possibly a replacement of plagioclase.

Reference No. 692
Sample No. STR16-18

Leucocratic syenite.

Field Description. Medium to coarse grained, inequigranular-seriate, weakly trachytoidal. Outcrop has local shear zones, but the sample is unsheared. Weathered and fresh surfaces are mottled pink, bluish grey and black. Colour index 10-15%. Map unit 5a.

Petrographic Description. Fine to coarse grained, inequigranular-seriate, allotriomorphic, cataclastic with curved to interdigitating grain boundaries. Epidote, actinolite and biotite form mats of intermixed crystals after an unknown mafic mineral. Plagioclase (An2-7) forms irregular, interlocking mosaics of untwinned and twinned grains; larger grains have well developed protoclastic textures and patchy perthite replacement. Fractured microcline forms large anhedral, ragged grains containing vestiges of plagioclase with protoclastic texture. Sample appears crushed and recrystallized.

Reference No. 693
Sample No. STR17-2A

Leucocratic syenite.

Field Description. Medium to coarse grained, inequigranular-seriate. Weathered surfaces are pitted and altered nepheline weathers reddish pink. Weathered surfaces are mottled pink, greyish blue and grey-black; fresh surfaces are mottled bluish grey and black. Map unit 5b.

Petrographic Description. Fine to coarse grained, massive, inequigranular-seriate, allotriomorphic with curved to interdigitating grain boundaries. Some recrystallization is evident along margins of feldspar grains. Sphene forms euhedral crystals. Garnet is of two types: dark brown, euhedral crystals (melanite)? and turbid, colourless, anhedral crystals. The colourless type may be grossularite and is an alteration product. Biotite forms large grains in association with garnet. Plagioclase generally forms anhedral grains, interstitial to larger microcline grains. The microcline is anhedral and weakly protoclastic.

Reference No. 694
Sample No. STR17-3

Cancrinite syenite.

Field Description. Medium to coarse grained, inequigranular-seriate, massive. Weathered surfaces are pitted, possibly from altered nepheline. Colour index 20-25%. Weathered and fresh surfaces are mottled pink and black. Map unit 5a.

Petrographic Description. Fine to coarse grained, inequigranular-seriate, allotriomorphic with curved to interdigitating grain boundaries. Cancrinite is interstitial to feldspar. Biotite, epidote and actinolite form interlocking aggregates of grains after an unknown primary mafic mineral. Plagioclase (An6) forms anhedral, interlocking grains generally interstitial to larger microcline grains. Microcline forms large to small anhedral grains; larger grains have a crudely stringy perthite texture.

Reference No. 695
Sample No. STR17-5

Cancrinite syenite.

Field Description. Medium to coarse grained, massive, inequigranular-seriate. Feldspars are up to 5 cm in length. Colour index approximately 20%. Weathered and fresh surfaces are mottled pink and black. Map unit 5a.

Petrographic Description. Fine to coarse grained, massive, inequigranular-seriate, allotriomorphic with curved to interdigitating grain boundaries. Garnet, biotite and epidote form interlocking aggregates after unknown mafic mineral. Zircon forms very small grains with radioactive haloes. Nepheline is altered to cancrinite which forms interstitial clear grains. Plagioclase (An2) forms an interlocking mosaic of anhedral grains with microcline. Plagioclase has patchy potassium replacement.

Reference No. 696
Sample No. STR17-7

Nepheline-bearing syenite.

Field Description. Medium to coarse grained, massive, inequigranular-seriate. Feldspars in some areas of outcrop are 4 to 5 cm long. Colour index approximately 20%. Weathered and fresh surfaces are pinkish buff and black; some weathered surfaces are pitted. Map unit 5a.

Petrographic Description. Fine to coarse grained, massive, inequigranular–seriate, allotriomorphic with curved to lobate grain boundaries. Epidote, garnet, and biotite form interlocking aggregates after an unknown mafic mineral. Zircons have radioactive haloes. Plagioclase (An4–8) forms anhedral, irregular grains interlocking with microcline. Plagioclase has weak protoclastic texture and microcline has wavy extinction. Very minor interstitial nepheline is present.

Reference No. 697
Sample No. STR17–8

Cancrinite syenite.

Field Description. Medium to coarse grained, inequigranular–seriate, massive, weakly trachytoidal. Colour index 15–20%. Weathered and fresh surfaces are mottled pink and black. Weathered surfaces are pitted. Map unit 5a.

Petrographic Description. Fine to coarse grained, inequigranular–seriate, allotriomorphic with curved to interdigitating grain boundaries. Sericite and zeolite are after nepheline; interstitial cancrinite may be after nepheline. Garnet, biotite and epidote (?) form interlocking aggregates after an unknown mafic mineral. Plagioclase (An2–6) forms an interlocking mosaic of anhedral grains with microcline. Microcline has local stringy perthite texture. Some of the larger grains have marginal zones of fine–grained feldspar possibly representing recrystallized crushed margins of the crystals.

Reference No. 698
Sample No. STR17–9

Cancrinite syenite.

Field Description. Medium to coarse grained, inequigranular–seriate, weakly trachytoidal. Colour index approximately 20%. Weathered and fresh surfaces are pinkish buff and black. Map unit 5a.

Petrographic Description. Fine to coarse grained, massive, inequigranular–seriate, allotriomorphic with curved to lobate grain boundaries. Garnet and biotite form an interlocking aggregate of grains after unknown mafic minerals. Garnet is anhedral, turbid, and colourless. Plagioclase (An6) forms anhedral crystals generally a little smaller than the microcline. Microcline forms irregular, anhedral grains interlocking with plagioclase. Some microcline grains have a slightly patchy perthite texture.

Reference No. 699
Sample No. STR18–33A

Biotite garnet syenite.

Field Description. Fine to medium grained, equigranular, massive. Colour index 5–10%. Weathered and fresh surfaces are grey with black flecks. Coarse grained phases are also present in outcrop. Map unit 5c.

Petrographic Description. Medium grained, equigranular, massive, allotriomorphic with curved to lobate grain boundaries. Biotite forms anhedral books in close association with garnet and epidote. Garnet forms anhedral grains generally turbid and colourless. Epidote occurs as highly birefringent grains in association with garnet and biotite. Plagioclase (An6) forms an interlocking mosaic of grains, some with protoclastic textures; others display patchy replacement by potassium feldspar. Potassium feldspar occurs as patchy replacement of plagioclase.

Reference No. 700
Sample No. STR18–33B

Garnet nepheline syenite.

Field Description. Fine to medium grained, equigranular, massive. Colour index less than 10%. The sample is coarser grained than sample STR18–33A. Weathered and fresh surfaces are pinkish buff with black spots. Map unit 5c.

Petrographic Description. Medium to coarse grained, equigranular, massive, allotriomorphic with curved grain boundaries. Garnet occurs as subhedral, brown crystals. Nepheline is interstitial, moderately unaltered. Epidote and biotite form discrete aggregates of anhedral grains, probably an alteration of mafic minerals. Plagioclase (An6–10) forms an interlocking mosaic of grains. Larger grains have a protoclastic texture. Potassium feldspar is largely a replacement of the plagioclase. Vestiges of microline twinning were noted.

Reference No. 701
Sample No. STR18–34A

Leucocratic syenite.

Field Description. Fine to medium grained, equigranular, massive. Colour index approximately 5%. Weathered and fresh surfaces are pinkish buff with scattered black spots. Map unit 5c.

Petrographic Description. Medium grained, massive, equigranular, allotriomorphic with curved grain boundaries. Garnet forms anhedral, dark brown grains. Pyroxene (aegirine-augite) forms relatively small anhedral grains. Epidote and biotite form an interlocking aggregate of anhedral crystals. Plagioclase (An4-8) forms an interlocking mosaic of grains with some patchy potassium feldspar replacement. Microcline forms part of the interlocking mosaic with plagioclase.

Reference No. 702
Sample No. STR18-35

Leucocratic syenite.

Field Description. Medium grained, equigranular, massive. Colour index approximately 10%. Weathered and fresh surfaces are buff, flecked with black. Map unit 5c.

Petrographic Description. Medium grained, equigranular, massive, allotriomorphic with curved to interdigitating grain boundaries. Garnet forms anhedral, brown grains. Biotite is closely associated with garnet along margins of grains, and has ragged outlines. Pyroxene (aegirine-augite) is uncommon, and is altering to biotite. Plagioclase (An7) forms an interlocking mosaic with microcline. There is some patchy replacement of plagioclase with potassium feldspar. Minor fluorite is present.

Reference No. 703
Sample No. STR18-36

Nepheline (altered) syenite.

Field Description. Fine to medium grained, equigranular, massive. Colour index less than 5%. Weathered and fresh surfaces are pinkish buff with scattered black spots. Map unit 5c.

Petrographic Description. Medium grained, massive, equigranular, allotriomorphic with curved grain boundaries. Zeolite occurs as fibrous interstitial masses. Cancrinite is interstitial. Biotite with minor epidote forms fine-grained aggregates after an unidentified mafic mineral. Plagioclase (An2-4) forms an interlocking mosaic with microcline.

Reference No. 704
Sample No. STR18-37B

Garnet, biotite syenite.

Field Description. Fine grained, equigranular, massive. Colour index approximately 20%. Weathered and fresh surfaces are dark grey. This mafic phase is cut by a leucocratic phase. Map unit 5c.

Petrographic Description. Fine grained, massive, equigranular, allotriomorphic with lobate to interdigitating grain boundaries. Biotite forms ragged anhedral crystals. Garnet forms small, turbid, anhedral, colourless, weakly birefringent grains. Plagioclase (An7?) forms an interlocking mass of anhedral grains. The rock is metamorphosed.

Reference No. 705
Sample No. STR18-38

Garnet, biotite syenite.

Field Description. Medium grained, inequigranular, massive. Colour index approximately 10%. Weathered and fresh surfaces are pinkish buff with black spots. Map unit 5c.

Petrographic Description. Medium grained, massive, equigranular, allotriomorphic with curved grain boundaries. Biotite and actinolite? form fine-grained aggregates, possibly after pyroxene. Garnet is dark brown, subhedral, with some amoeboid plagioclase inclusions. Plagioclase forms an interlocking mosaic with microcline.

Reference No. 706
Sample No. STR18-39

Nepheline syenite.

Field Description. Fine to medium grained, massive, equigranular. Colour index 15-20%. A non-leucocratic phase of the dominantly leucocratic syenite of the core. Biotite tends to be clotty. Weathered and fresh surfaces are grey flecked with black. Map unit 5c.

Petrographic Description. Medium grained, equigranular, massive, allotriomorphic with curved grains boundaries. Biotite forms large books in association with pyroxene. Pyroxene is a green, subhedral aegirine-augite. Plagioclase (An4-9) and microcline form an interlocking mosaic of grains. Nepheline is fresh and interstitial.

Reference No. 707
Sample No. STR18-40A

Nepheline syenite.

Field Description. Fine to medium grained, equigranular, massive. Colour index less than 5%. Weathered and fresh surfaces are pinkish buff. Map unit 5c.

Petrographic Description. Medium grained, massive, equigranular, allotriomorphic with curved grain boundaries. Nepheline forms clear, relatively fresh grains, containing oriented, highly birefringent inclusions of possible sericite. Pyroxene (aegirine-augite) forms subhedral to anhedral grains with ragged edges and is undergoing alteration along the rim. Plagioclase (An4-6) forms an interlocking mosaic with microcline.

Reference No. 708
Sample No. STR18-40B

Aegirine-augite (altered) syenite.

Field Description. Fine to medium grained, equigranular, massive. Colour index less than 5%. Weathered and fresh surfaces are pinkish buff with scattered black spots. Map unit 5c.

Petrographic Description. Medium grained, massive, equigranular, allotriomorphic with curved to lobate grain boundaries. Some pyroxene appears to be altered to a very fine-grained mat of biotite; other grains retain the green of aegirine-augite but are turbid. Plagioclase and microcline form an interlocking mosaic of anhedral grains.

Reference No. 709
Sample No. STR18-41A

Aegirine-augite syenite.

Field Description. Medium to coarse grained, inequigranular-seriate. Colour index 15 to 20%. This is a coarser-grained phase of map unit 5c. Weathered and fresh surfaces are mottled pinkish buff and black. The outcrop is dominantly leucocratic and medium grained. Map unit 5c.

Petrographic Description. Medium grained, massive, equigranular, allotriomorphic with lobate to interdigitating grain boundaries. Pyroxene forms anhedral, ragged grains of aegirine-augite altering to garnet and biotite. Garnet and biotite forms an interlocking aggregate of grains after pyroxene. Microcline and plagioclase (An8-10) forms an interlocking mosaic.

Reference No. 710
Sample No. STR18-41B

Leucocratic syenite.

Field Description. Fine to medium grained, massive, inequigranular-seriate. Biotite forms isolated grains up 2 mm in diameter. Colour index approximately 20%. Weathered and fresh surfaces are dark grey. The rock is probably a block or xenolith in the more leucocratic phase. Map unit 5c.

Petrographic Description. Fine grained, massive, equigranular, allotriomorphic with lobate to interlocking grain boundaries. Biotite and garnet form composite interlocking aggregates after unknown mafic minerals. Plagioclase and potassium feldspar form an interlocking mosaic.

Reference No. 711
Sample No. STR18-41C

Aegirine-augite syenite.

Field Description. Medium to coarse grained, inequigranular-seriate. Weathered surfaces are pitted and altered nepheline is buff. Colour index approximately 10%. The sample is a coarse grained phase of leucocratic nepheline syenite. Weathered and fresh surfaces are buff with grey and black flecks. Map unit 5c.

Petrographic Description. Medium to coarse grained, massive, equigranular, allotriomorphic with curved grain boundaries. Pyroxene is turbid aegirine-augite with ragged anhedral outlines. Garnet and biotite are alteration products of pyroxene and form an interlocking mosaic of anhedral grains. Plagioclase displays weak protoclastic texture and patchy replacement by potassium feldspar.

Reference No. 712
Sample No. STR18-44

Leucocratic syenite.

Field Description. Fine to medium grained, equigranular, massive. The outcrop locally has pegmatitic segregations. Colour index approximately 5%. Weathered and fresh surfaces are buff with black spots. Map unit 5c.

Petrographic Description. Fine grained, massive, equigranular, allotriomorphic with lobate to interdigitating grain boundaries. Biotite forms felty masses after pyroxene, and occurs as isolated grains in less altered pyroxene. Pyroxene is a twinned green aegirine-augite with worm-eaten appearance and is undergoing alteration to biotite. Plagioclase (An9) forms an interlocking mosaic. Minor interstitial microcline is present.

Reference No. 713
Sample No. STR18-45

Leucocratic cancrinite syenite.

Field Description. Fine to medium grained, equigranular, massive. Colour index 10%. Weathered and fresh surfaces are buff flecked with black. Map unit 5c.

Petrographic Description. Fine grained, equigranular, massive, allotriomorphic with lobate to interdigitating grain boundaries. Plagioclase (An7-8) forms an interlocking mosaic with grains of microcline; some plagioclase has a weak protoclastic texture. Pyroxene (aegirine-augite) forms anhedral crystals altering to biotite, and has a worm-eaten appearance. Biotite occurs as an alteration after pyroxene and as isolated grains. Cancrinite is interstitial to feldspar. Scapolite (?) occurs as birefrigent prismatic grains. Euhedral sphene is present.

Reference No. 715
Sample No. STR18-46B

Garnet, biotite syenite.

Field Description. Fine to medium grained, equigranular, massive. Colour index approximately 20%. The sample is a mafic phase of unit 5c. Most of the outcrop is leucocratic. Weathered and fresh surfaces are mottled grey. Map unit 5c.

Petrographic Description. Fine grained, massive, equigranular, allotriomorphic with curved to lobate grain boundaries. Biotite forms anhedral, irregular grains in association with garnet. Garnet forms irregular, turbid, colourless grains in association with biotite. Microcline and plagioclase (An4-9) form an interlocking mosaic of grains with curved to lobate grain boundaries. Plagioclase has well developed protoclastic texture.

Reference No. 716
Sample No. STR18-46C

Leucocratic cancrinite syenite.

Field Description. Fine to medium grained, massive, equigranular. Colour index approximately 10%. Weathered and fresh surfaces are buff to pinkish buff with black spots. This sample is typical of the dominant phase in outcrop. Map unit 5c.

Petrographic Description. Fine grained, massive, equigranular, allotriomorphic with curved grain boundaries. Relict pyroxenes of light green, ragged aegirine-augite are altering to biotite in part. Cancrinite is interstitial to feldspars. Plagioclase (An7-9) forms an interlocking mosaic of grains with minor microcline.

Reference No. 717
Sample No. STR18-48

Nepheline syenite.

Field Description. Medium to coarse grained, inequigranular-seriate, massive. Colour index 15%. Weathered and fresh surfaces are bluish grey and black. Map unit 5a.

Petrographic Description. Medium grained, equigranular, massive, allotriomorphic, with curved grain boundaries. Traces of fluorite are interstitial. Nepheline forms anhedral, interstitial grains which are weakly altered to sericite (?). Minor zircon has radioactive haloes. Garnet forms anhedral, turbid, colourless grains in association with biotite. Biotite forms anhedral booklets in association with garnet. Microcline and plagioclase (An6-8) grains form an interlocking mosaic.

Reference No. 718
Sample No. STR18-52

Nepheline syenite.

Field Description. Medium to coarse grained, massive, inequigranular-seriate. Colour index approximately 20%. Weathered and fresh surfaces are mottled bluish grey and black. Map unit 5a.

Petrographic Description. Fine to coarse grained, inequigranular-seriate, allotriomorphic with curved to interdigitating grain boundaries. Zircon occurs in trace amounts and has radioactive haloes. Biotite forms large books, some with bent (001) cleavage planes. Garnet forms anhedral, irregular grains in association with biotite. Sphene is euhedral to anhedral. Epidote (?) forms birefringent grains in association with biotite and garnet. Nepheline forms interstitial grains and inclusions in larger perthite grains. Plagioclase (An4-8) forms an interlocking mosaic. Plagioclase tends to occur as smaller grains marginal to larger perthite grains which also contain smaller plagioclase grains in random orientation. Perthite is crudely patchy and appears to be a coarse string perthite.

Reference No. 719
Sample No. STR18-58

Biotite syenite.

Field Description. Medium to coarse grained, inequigranular-seriate, weakly trachytoidal. Colour index 10-15%. Weathered and fresh surfaces are pinkish buff with black spots. Map unit 5a.

Petrographic Description. Fine to coarse grained, inequigranular-seriate, allotriomorphic with curved to lobate grain boundaries. Traces of zircon have radioactive haloes. Biotite forms large clusters of crystals in aggregates. Plagioclase (An7-12) forms an interlocking mosaic of anhedral grains with perthite. Perthite grains are a bit larger than plagioclase and have a crude stringy perthite texture.

Reference No. 720
Sample No. STR18-59

Biotite syenite.

Field Description. Medium to coarse grained, massive, inequigranular-seriate. Colour index 15-20%. Weathered surfaces are grey with black; fresh surfaces are mottled pinkish buff and black. Map unit 5a.

Petrographic Description. Fine to coarse grained, massive, inequigranular-seriate, allotriomorphic with curved to interdigitating grain boundaries. Biotite forms elongate clots or aggregates. Plagioclase (An6-11) forms an anhedral interlocking mosaic with perthite and microcline. Microcline forms clear colourless grains. Perthite is patchy. Plagioclase shows potassium feldspar replacement.

Reference No. 721
Sample No. STR19-1

Nepheline syenite.

Field Description. Medium to coarse grained, massive, inequigranular-seriate. Colour index 20-25%. Weathered and fresh surfaces are mottled pinkish buff and black. Map unit 5a.

Petrographic Description. Fine to medium grained, massive, equigranular-seriate, allotriomorphic with curved to straight grain boundaries. Zeolite forms massive, fibrous aggregates presumably after nepheline. Biotite and epidote (?) form very fine-grained aggregates after a former primary mafic mineral. Nepheline forms irregular relicts rimmed with cancrinite and zeolite. The grains are anhedral and interstitial and flecked with very fine-grained alteration products. Cancrinite is anhedral, interstitial to feldspar and presumably an alteration of nepheline. Plagioclase (An7-11) forms anhedral grains in an interlocking aggregate along margins of larger perthite grains. Perthite is microcline with a well developed stringy texture. Crystals are anhedral in form and may partially enclose some plagioclase grains.

Reference No. 722
Sample No. STR19-2

Nepheline (altered) syenite.

Field Description. Medium to coarse grained, inequigranular-seriate, trachytoidal. Colour index approximately 20%. Weathered and fresh surfaces are mottled pink and black. Map unit 5a.

Petrographic Description. Fine to coarse grained, massive, inequigranular-seriate, allotriomorphic with curved to interdigitating grain boundaries. Sphene forms euhedral, wedge-shaped crystals. Sericite forms very fine-grained aggregates after nepheline (?). Epidote occurs in association with biotite. Biotite is locally after pyroxene; other primary grains are anhedral and irregular in outline. Plagioclase forms an interlocking mosaic (An5) with microcline perthite.

Perthite is stringy and includes grains of plagioclase. Minor actinolite and possibly some scapolite(?) are present.

Reference No. 723
Sample No. STR19-5

Nepheline (altered) syenite.

Field Description. Medium to coarse grained, inequigranular-seriate-porphyritic. Colour index approximately 20%. Weathered and fresh surfaces are pinkish grey and black. Map unit 5a.

Petrographic Description. Fine to coarse grained, massive, inequigranular-seriate, allotriomorphic with curved to interdigitating grain boundaries. Zeolite forms a fibrous mass after nepheline. Biotite forms anhedral crystals associated with garnet and zircon with radioactive haloes. Plagioclase (An2-7) forms an interlocking mosaic with microcline. Plagioclase grains are a little smaller than microcline. Plagioclase forms anhedral grains in random orientation within microcline.

Reference No. 724
Sample No. STR19-9

Garnet, biotite syenite.

Field Description. Medium to coarse grained, trachytoidal, inequigranular-porphyritic-seriate. Feldspar crystals up to 2 cm have a seriate distribution. Colour index 20-25%. Weathered and fresh surfaces are mottled pink and black. Map unit 5a.

Petrographic Description. Fine to coarse grained, massive, inequigranular-porphyritic-seriate, allotriomorphic with lobate grain boundaries. Biotite, garnet and epidote form an anhedral, interlocking mosaic, possibly after a former mafic mineral. Zircon with radioactive haloes occurs as tiny inclusions in biotite. Plagioclase forms minor interstitial perthite; the composition could not be determined. Microcline is a string perthite, locally crudely patchy.

Reference No. 725
Sample No. STR19-11

Syenodiorite.

Field Description. Medium grained, massive, equigranular. Colour index approximately 40%. Weathered surfaces are brown, fresh surfaces mottled brown with black. Map unit 5j.

Petrographic Description. Fine to medium grained, equigranular, massive, allotriomorphic with curved to lobate grain boundaries. Biotite forms anhedral, irregular grains with bent (001) cleavages. Biotite commonly mantles pyroxene. Pyroxene (augite) occurs as relicts mantled with biotite. Grains are colourless to very pale green. Minor, very pale amphibole is present. Plagioclase (An5?) forms an interlocking mosaic with microcline.

Reference No. 726
Sample No. STR19-12

Nepheline (altered) syenite.

Field Description. Medium to coarse grained, massive, inequigranular-seriate. Colour index approximately 20%. Weathered and fresh surfaces are mottled pink and black. Map unit 5c.

Petrographic Description. Fine to coarse grained, inequigranular-seriate, allotriomorphic with curved grain boundaries. Garnet and biotite form aggregates of interlocking grains. Nepheline forms anhedral, interstitial grains altered to a zeolite (?). Plagioclase (An5-8) forms an anhedral, interlocking mosaic with microcline. Plagioclase has a protoclastic texture.

Reference No. 727
Sample No. STR19-14A

Biotite, garnet syenite.

Field Description. Medium to coarse grained, inequigranular-porphyritic-seriate. Colour index 20-25%. Weathered and fresh surfaces are mottled pink and black. Map unit 5a.

Petrographic Description. Fine to coarse grained, massive, equigranular-seriate, allotriomorphic with curved grain boundaries. Zircon forms small grains with radioactive haloes. Garnet and biotite grains forms anhedral aggregates. Garnet forms colourless, turbid small grains and also large, dark brown grains. Sphene forms euhedral crystals. Plagioclase grains (An7) forms an interlocking mosaic with perthitic microcline. Microcline contains subhedral grains of plagioclase.

Reference No. 728
Sample No. STR19-15

Biotite, garnet syenite.

Field Description. Medium to coarse grained, inequigranular-porphyritic-seriate, massive. Nepheline may be present. Colour index 20-25%. Weathered and fresh surfaces are mottled pinkish buff and black. Feldspar crystals up to 2.5 cm in diameter have a seriate distribution. Map unit 5a.

Petrographic Description. Fine to coarse grained, massive, inequigranular-seriate, allotriomorphic with curved to interdigitating grain boundaries. Zircon with radioactive haloes occurs in biotite. Garnet and biotite forms anhedral, interlocking grains perhaps after pyroxene. Nepheline has been replaced by fibrous aggregates of zeolite. Plagioclase forms an interlocking mosaic with microcline. Microcline grains are anhedral, somewhat larger than plagioclase, and contain plagioclase inclusions. Microcline is a crudely stringy perthite.

Reference No. 729
Sample No. STR19-16

Nepheline-bearing biotite syenite.

Field Description. Medium to coarse grained, massive, inequigranular-seriate. Colour index approximately 20-25%. Weathered and fresh surfaces are mottled pinkish grey and black. Map unit 5a.

Petrographic Description. Fine to coarse grained, massive, inequigranular-seriate, allotriomorphic with curved grain boundaries. Biotite forms fine-grained aggregates, possibly after former mafic minerals. Nepheline forms clear, isolated blebs within microcline perthite. The nepheline contains scattered birefringent inclusions. Plagioclase (An10) and microcline grains form an anhedral interlocking mosaic. Microcline is a string perthite.

Reference No. 730
Sample No. STR19-18

Nepheline syenite.

Field Description. Medium to coarse grained, massive, inequigranular-seriate. Colour index 20-25%. Weathered and fresh surfaces are mottled pink and black. The sample contains a fine-grained, mafic xenolith which was removed before analysis. Map unit 5a.

Petrographic Description. Fine and coarse grained, massive, inequigranular- seriate, allotriomorphic with curved grain boundaries. Nepheline forms anhedral, interstitial grains with some birefringent inclusions. Zeolites are fibrous and interstitial to feldspar. Traces of actinolite form ragged grains possibly after aegirine-augite. Microcline is a string perthite. Garnet and biotite form an interlocking mixture probably after former mafic minerals.

Reference No. 731A
Sample No. STR26-1

Syenodiorite.

Field Description. Medium grained, massive, equigranular. Colour index 45%. Weathered surfaces are reddish brown, fresh surfaces mottled red and black. Map unit 5j.

Petrographic Description. Medium grained, equigranular, massive, allotriomorphic with curved to lobate grain boundaries. Altered pyroxene (augite?) is turbid and appears to be altering to actinolite. Biotite forms anhedral books with ragged edges and is associated with altered pyroxene. Microcline is a string perthite in part and occurs as an interlocking mosaic of anhedral grains with plagioclase (An2-8).

Reference No. 731B
Sample No. STR26-4

Syenodiorite.

Field Description. Medium grained, equigranular, massive. Colour index 45%. Weathered surfaces are reddish brown, fresh surfaces mottled pinkish red and black. The outcrop is cut by aphanitic aplite dikes. Map unit 5j.

Petrographic Description. Medium grained, massive, equigranular, allotriomorphic with curved grain boundaries. Quartz is anhedral and interstitial. Amphibole forms anhedral to subhedral grains with moderately dark green colour. Amphibole is a sodium-iron variety. Biotite forms

ragged, anhedral grains in association with amphibole. Plagioclase (An2-6) forms an interlocking mosaic of anhedral grains with curved grain boundaries.

Reference No. 732
Sample No. WST13-1

Syenodiorite.

Field Description. Medium grained, massive, equigranular. Colour index 25-30%. Weathered and fresh surfaces are bluish grey and greenish black. The sample is a finer-grained phase of map unit 5a. Map unit 5a.

Petrographic Description. Fine to coarse grained, equigranular, allotriomorphic with curved grain boundaries. Plagioclase (An33) grains form interstitial aggregates and large grains are undergoing patchy replacement. Traces of euhedral sphene are present. Garnet forms large, dark brown, subhedral grains and also occurs in a fine-grained mixture with epidote(?) and biotite as an alteration after former mafic minerals. The fine-grained garnet is colourless. Microcline forms large Carlsbad-twinned grains of anhedral outline. Minor untwinned plagioclase occurs along peripheries of grains. Some string perthite has wavy extinction.

Reference No. 733
Sample No. WST14-1

Garnet, biotite syenite.

Field Description. Medium to coarse grained, massive, inequigranular-porphyritic-seriate. Colour index 35-40%. Some pitting is evident on weathered surfaces. Weathered and fresh surfaces are mottled bluish grey and black. Map unit 5b.

Petrographic Description. Fine to coarse grained, massive, inequigranular-seriate, allotriomorphic with curved to straight grain boundaries. Garnet, epidote and biotite forms fine-grained, polycrystalline aggregates, possibly after amphibole. Plagioclase forms anhedral grains, interstitial to larger grains of microcline and plagioclase. Microcline forms large anhedral grains with Carlsbad twinning, wavy extinction and some string perthite texture. Euhedral sphene is common. Some cancrinite(?) is after nepheline(?).

Reference No. 734
Sample No. WST14-6

Leucocratic syenite.

Field Description. Medium to coarse grained, inequigranular-seriate, weakly trachytoidal. Colour index approximately 15%. Weathered and fresh surfaces are mottled pinkish buff and black. Map unit 5a.

Petrographic Description. Fine to coarse grained, massive, inequigranular, allotriomorphic with curved to interdigitating grain boundaries. Biotite forms large anhedral books. Garnet forms large, irregular, anhedral, turbid grains; it is possibly grossularite. Plagioclase (An28-30) forms isolated grains entrapped at random in microcline perthite and occurs as composite mosaics between larger feldspar grains. Microcline forms large anhedral grains with wavy extinction and string perthite. Some patch perthite results from replacement of larger plagioclase grains with potassium feldspar.

Reference No. 735
Sample No. WST14-17

Cancrinite syenite.

Field Description. Medium to coarse grained, massive, weakly trachytoidal, equigranular. Colour index 15-20%. Weathered and fresh surface mottled pinkish buff and black. Map unit 5a.

Petrographic Description. Fine to coarse grained, massive, inequigranular-seriate, allotriomorphic with curved to interdigitating grain boundaries. Biotite forms booklets interstitial to feldspar. Cancrinite forms anhedral, interstitial grains. Plagioclase (An40) forms anhedral, interdigitating mosaics between larger grains. Some larger plagioclases have protoclastic textures. Microcline forms large anhedral grains with Carlsbad twinning, locally with fracturing of grains and wavy extinction.

Reference No. 736
Sample No. WST18-3

Cancrinite syenite.

Field Description. Medium to coarse grained, inequigranular-seriate, massive, homogeneous. Some pitting on weathered surface is possibly from nepheline. Colour index 15-20%. Weathered and fresh surfaces are pinkish buff with greenish black specks. Map unit 5a.

Petrographic Description. Fine to coarse grained, inequigranular–seriate, allotriomorphic with curved grain boundaries. Aegirine–augite forms subhedral grains of green colour. Cores of grains are paler green than rims suggesting zoning. Cancrinite forms interstitial grains between feldspars. Plagioclase (An6–8) grains form an interlocking mosaic with microcline. Minor apatite is present.

Reference No. 737
Sample No. WST18–4A

Cancrinite syenite.

Field Description. Fine grained, massive, equigranular. In outcrop coarse grained segregations are present. Colour index approximately 5%. Some pitting is evident on weathered surfaces. Weathered and fresh surfaces are grey to buff. Map unit 5d.

Petrographic Description. Fine grained, massive, equigranular, allotriomorphic with lobate to interdigitating grain boundaries. Biotite, actinolite and garnet form composite aggregates after an unknown mafic mineral. Plagioclase (An2) forms an interlocking mosaic of anhedral grains.

Reference No. 738
Sample No. WST18–7B

Leucocratic nepheline syenite.

Field Description. Fine grained, equigranular, trachytoidal, leucocratic. Colour index essentially zero. Weathered and fresh surfaces are pinkish buff. This phase is gradational into a coarser grained phase. Map unit 5c.

Petrographic Description. Fine to coarse grained, inequigranular, massive, allotriomorphic with curved grain boundaries. Biotite forms ragged, anhedral grains. Cancrinite forms irregular grains partially enclosing feldspar. Plagioclase (An33?) forms irregular twinned and untwinned grains, interstitial to larger grains. Larger plagioclases form patch perthite or show patchy replacement by potassium feldspar. Microcline forms large anhedral grains with wavy extinction and rimmed by fine–grained, untwinned, recrystallized plagioclase with interdigitating grain boundaries.

Reference No. 739
Sample No. WST18–8A

Cancrinite syenite.

Field Description. Fine grained, equigranular, massive, leucocratic. Colour index 5–10%. Weathered and fresh surfaces are pinkish buff. Map unit 5d.

Petrographic Description. Fine grained, massive, equigranular, allotriomorphic with interdigitating grain boundaries. Cancrinite forms irregular, interstitial grains. Aegirine–augite forms anhedral, irregular grains. Biotite forms booklets altering from augite. Plagioclase (An6–10) and potassium feldspar grains form anhedral, interlocking mosaics. Plagioclase displays weak to moderate protoclastic texture.

Reference No. 740
Sample No. WST18–8B

Cancrinite syenite.

Field Description. Coarse grained, massive, equigranular, leucocratic. Colour index 5–10%. Weathered and fresh surfaces are pinkish buff. This sample is a coarse grained phase gradational in the finer grained phase of sample WST18–8A. Map unit 5b.

Petrographic Description. Fine to coarse grained, massive, inequigranular–seriate, allotriomorphic with curved to interdigitating grain margins. Cancrinite forms interstitial grains. Aegirine–augite forms anhedral to euhedral, irregular grains. Euhedral sphene crystals are present. Potassium feldspar, in part microcline, forms an interlocking mosaic with plagioclase grains (An2–6). Potassium feldspar forms a patchy replacement of plagioclase which also has a weakly protoclastic texture.

Reference No. 741
Sample No. WST18–10

Nepheline (?) syenite.

Field Description. Medium to coarse grained, massive, equigranular. In outcrop grain size is variable and locally pegmatitic. Colour index 1–2%. Weathered and fresh surfaces are pinkish buff. Map unit 5c.

Petrographic Description. Fine to medium grained, inequigranular-seriate, allotriomorphic with interdigitating grain boundaries. Aegirine-augite forms irregular, anhedral grains, locally altered to aggregates of biotite and epidote. Zeolites are fibrous, interstitial to feldspars. Plagioclase (An4-8) forms an interlocking mosaic with microcline and crudely stringy perthite. Minor euhedral sphene and dark brown garnet were noted.

Reference No. 742
Sample No. WST18-18

Leucocratic syenite.

Field Description. Medium to coarse grained, equigranular, massive. Colour index 10-15%. Weathered and fresh surfaces are pinkish buff. Map unit 5c.

Petrographic Description. Fine to coarse grained, massive, inequigranular-seriate, allotriomorphic with curved grain boundaries. Biotite forms dark brown discrete grains. Plagioclase (An4-6) forms an interlocking mosaic of grains with potassium feldspar. The potassium feldspar is dominantly microcline with crude string perthite texture.

Reference No. 743
Sample No. WST18-20

Nepheline syenite.

Field Description. Medium to coarse grained, inequigranular-seriate, weakly trachytoidal. Colour index approximately 20%. Weathered and fresh surfaces are mottled greyish pink and black. Map unit 5a.

Petrographic Description. Fine to medium grained, inequigranular-seriate, allotriomorphic with curved grain boundaries. Garnet and biotite form interlocking aggregates locally with relict cores of turbid aegirine-augite (?). Zircon in biotite has radioactive haloes. Nepheline and cancrinite are interstitial. Nepheline stains deeply. Plagioclase and microcline form interlocking mosaics. Microcline has a crude stringy perthite texture.

Reference No. 744
Sample No. WST18-21

Garnet, biotite syenite.

Field Description. Fine to medium grained, massive. Colour index approximately 5%. Weathered and fresh surfaces are pinkish buff. Map unit 5d.

Petrographic Description. Fine grained, equigranular, massive, allotriomorphic with curved grain boundaries. Biotite, epidote and garnet form interlocking aggregates, possibly replacing pyroxene. Trace to minor aegirine-augite (?) was noted. Plagioclase (An5-10) forms an interlocking mosaic with potassium feldspar. Potassium feldspar consists of patch perthite (plagioclase replacement) and microcline. Plagioclase has weak protoclastic texture.

Reference No. 745
Sample No. WST18-25

Biotite, aegirine-augite syenite.

Field Description. Medium grained, equigranular, massive. Colour index approximately 30%. Weathered surfaces are pitted from weathering out of mafic minerals. Weathered surfaces are reddish brown, fresh surfaces mottled reddish brown and black. The rock is probably a xenolithic block in map unit 5b. Map unit 5j.

Petrographic Description. Medium grained, equigranular, massive, allotriomorphic with curved to lobate grain boundaries. Pyroxene is an aegirine-augite and forms subhedral crystals with pale green cores and green rims indicating zoning. The green rims are gradational into the cores in some grains and in others the contact is irregular cuspate. Extinction angles vary 9° from core to rim. Biotite forms large books sometimes in association with pyroxene. Plagioclase (An2-10) and microcline form an interlocking, anhedral mosaic and display patchy saussuritization. Plagioclase is protoclastic and locally has slight patchy replacement by potassium feldspar.

Reference No. 746
Sample No. WST20-2

Nepheline syenite.

Field Description. Medium to coarse grained, massive, equigranular. Colour index approximately 20%. Weathered and fresh surfaces are buff and black. Map unit 5a.

Petrographic Description. Fine to coarse grained, massive, inequigranular–seriate, allotriomorphic with curved grain boundaries. Nepheline forms irregular grains with highly birefringent, very small inclusions. Biotite forms irregular anhedral grains with traces of poikilitic radioactive zircon. Plagioclase (An4–10) and microcline form interlocking mosaics. Microcline has a string perthite texture and contains random inclusions of plagioclase with turbid cores.

Reference No. 747
Sample No. WST20–3

Amphibole, aegirine–augite syenite.

Field Description. Medium to coarse grained, inequigranular–porphyritic–seriate, trachytoidal. Feldspar phenocrysts up to 4 cm in length compose approximately 30 to 40% of the rock. Weathered and fresh sufaces are mottled pale pink and black. Map unit 5a.

Petrographic Description. Fine to coarse grained, massive, inequigranular–seriate–porphyritic, allotriomorphic with curved grain boundaries. Pyroxene forms subrounded grains of pale green aegirine–augite. Amphibole is greenish brown, mantles pyroxene, and is a sodic variety. Microcline with string perthite texture occurs in anhedral grains.

Reference No. 748
Sample No. WST20–5

Melanocratic biotite, amphibole, pyroxene syenite.

Field Description. Medium grained, massive, equigranular. Colour index approximately 30%. Weathered and fresh surfaces are mottled pink and black. Map unit 5a.

Petrographic Description. Fine to medium grained, equigranular, allotriomorphic with curved grain boundaries. Biotite forms irregular, anhedral to subhedral grains and mantles pyroxenes. Pyroxene is augite. Amphibole forms dark green mantles on the pyroxenes and locally completely replaces pyroxene. Amphibole is probably sodic. Plagioclase and microcline form an interlocking mosaic.

Reference No. 749
Sample No. WST20–8

Syenodiorite.

Field Description. Medium grained, massive, equigranular. Colour index approximately 35%. Weathered and fresh surfaces are mottled pink and black. Map unit 5j.

Petrographic Description. Fine to medium grained, massive, equigranular, allotriomorphic with curved grain boundaries. Pyroxene forms subhedral to anhedral grains of clear, colourless augite. Larger grains display zoning. Biotite forms large books and mantles pyroxene. Minor magnetite, locally skeletal, was noted. Plagioclase (An 2–5) and microcline form interlocking mosaics. Some larger grains have saussuritized cores.

Reference No. 750
Sample No. WST20–11

Syenodiorite.

Field Description. Medium grained, equigranular, massive. Colour index 25–30%. Weathered and fresh surfaces are mottled pink and black. Map unit 5j.

Petrographic Description. Fine to coarse grained, massive, inequigranular–seriate, allotriomorphic with curved grain boundaries. Pyroxene (augite) forms relicts altering to biotite and chlorite. Biotite forms aggregates and clusters with minor actinolite and chlorite. It appears to be an alteration after pyroxene. Plagioclase (An6) and potassium feldspar form interlocking mosaics. Potassium feldspars have saussuritized cores. Weakly protoclastic texture is evident in plagioclase.

Reference No. 751
Sample No. WST20–13

Syenodiorite.

Field Description. Medium grained, equigranular, massive. Colour index 35–40%. Weathered and fresh surfaces are mottled pink and black. Map unit 5j.

Petrographic Description. Fine to medium grained, equigranular, massive, allotriomorphic with curved grain boundaries. Pyroxene forms clear colourless grains (augite) with alteration rims of

biotite; larger grains are weakly zoned and show patchy biotite alteration. Microcline forms interstitial grains along with small grains of string perthite. Plagioclase (An 6) grains form interlocking mosaics with potassium feldspars.

Reference No. 752
Sample No. WST20-14

Biotite, pyroxene syenite.

Field Description. Coarse grained, massive, inequigranular-seriate, homogeneous. Colour index 15-20%. Weathered and fresh surfaces are mottled reddish pink and black. Map unit 5a.

Petrographic Description. Fine to coarse grained, massive, inequigranular-seriate, allotriomorphic with curved grain boundaries. Pyroxene is mantled with biotite. Minor biotite mantles pyroxene and replaces pyroxene. There are a few isolated biotite grains. Plagioclase (An9) and microcline grains form interlocking mosaics, with microcline in part replacing the plagioclase.

Reference No. 754
Sample No. WST23-3

Cancrinite, nepheline, biotite syenite.

Field Description. Medium to coarse grained, inequigranular-seriate, weakly trachytoidal. Colour index 5-10%. Weathered and fresh surfaces are mottled pinkish grey and black. Map unit 5b.

Petrographic Description. Fine to coarse grained, massive, inequigranular-seriate, allotriomorphic with curved grain boundaries. Cancrinite forms anhedral, interstitial grains. Nepheline forms interstitial, irregular grains, with birefringent inclusions of sericite. Plagioclase (An 4-7) and microcline form interlocking mosaics of anhedral grains. Patchy replacement of plagioclase by potassium feldspar is evident. Biotite, garnet and minor actinolite and epidote form interlocking aggregates, mostly after pyroxene.

Reference No. 755
Sample No. WST23-8

Cancrinite, biotite syenite.

Field Description. Medium to coarse grained, massive, inequigranular-seriate. Colour index approximately 10%. Weathered and fresh surfaces are mottled pinkish grey and black. Map unit 5b.

Petrographic Description. Fine to coarse grained, cataclastic, inequigranular-seriate, allotriomorphic, with curved to interdigitating grain boundaries. Cancrinite forms anhedral interstitial masses. Actinolite is fibrous, acicular and associated with biotite. Biotite is anhedral, irregular in outline, with bent cleavage planes (001) and undulatory extinction. Plagioclase and microcline forms interlocking anhedral mosaics. Larger feldspar grains are fractured and healed with fine-grained, untwinned plagioclase(?). Zones of fine-grained, untwinned feldspars are recrystallized, with porphyroclasts of feldspar.

Reference No. 756
Sample No. WST25-4C

Syenodiorite.

Field Description. Fine to medium grained, massive, equigranular. Colour index approximately 45%. The rock extensively cuts mafic metavolcanics. Weathered surfaces are buff and black, fresh surfaces are pinkish grey and black. Map unit 5j.

Petrographic Description. Fine to medium grained, massive, equigranular, allotriomorphic with curved to interdigitating grain boundaries. Pyroxene (augite) forms subrounded to subhedral crystals mantled with biotite. Biotite mantles pyroxene and replaces pyroxene. Microcline perthite forms an interlocking mosaic of grains.

Reference No. 757
Sample No. WST25-7

Syenodiorite.

Field Description. Medium grained, massive, inequigranular-seriate. Large biotite grains up to and exceeding 1 cm are set in a largely medium-grained rock. Biotite may be porphyroblastic. Outcrop is cut by a fine- to medium-grained quartz feldspar dike approximately 4 cm wide. Weathered surfaces are buff, fresh surfaces mottled pinkish buff and black. Map unit 5n.

Petrographic Description. Fine to medium grained, equigranular, massive, allotriomorphic to hypidiomorphic. Pyroxene (augite) forms euhedral to anhedral crystals which contain poikilitic plagioclase and scattered grains of biotite. Biotite occurs as isolated grains with bent (001) cleavages and as mantles on pyroxene. Plagioclase (An7)? forms interlocking mosaics of anhedral grains with microcline. Microcline may, in part, be interstitial to plagioclase.

Reference No. 758
Sample No. WST25-8B

Syenodiorite.

Field Description. Medium grained, massive, equigranular. Weathered surfaces are buff and black, fresh surfaces pinkish buff and black. Colour index approximately 35%. This phase displays sharp contact relations with a similar finer-grained phase. Map unit 5j.

Petrographic Description. Medium grained, equigranular, massive, allotriomorphic with curved grain boundaries. Biotite forms aggregates of crystals in combination with minor epidote; biotite and epidote are after an unknown mineral, possibly pyroxene. Pyroxene (augite) forms ragged relicts heavily mantled with biotite. Plagioclase (An 7) and potassium feldspar form interlocking mosaics of anhedral grains. Potassium feldspar is moderately saussuritized. Plagioclase has moderate protoclastic texture.

Reference No. 759
Sample No. WST25-14

Syenodiorite.

Field Description. Medium grained, massive, equigranular, possibly very weakly trachytoidal. Colour index is approximately 35%. Weathered and fresh surfaces are mottled pink and black. Map unit 5j.

Petrographic Description. Fine to medium grained, massive, equigranular, allotriomorphic with curved grain boundaries. Pyroxene (augite?) forms relict cores to some of the larger amphibole crystals. Amphibole is pleochroic in green to brown and forms anhedral to subhedral crystals. Plagioclase (An 7) forms subhedral to anhedral grains. Potassium feldspar forms larger grains and sometimes encloses plagioclase grains. Weak to strong saussuritization of feldspars was noted.

Reference No. 760
Sample No. WST25-19

Syenodiorite.

Field Description. Medium grained, massive, equigranular. Colour index approximately 30%. Weathered and fresh surfaces are mottled pink and black. Mafic xenoliths up to 5 by 6 cm are present in outcrop. Xenolithic material is absent in sample. Several aplitic dikes up to 4 cm wide cut the outcrop. Map unit 5j.

Petrographic Description. Medium grained, equigranular, massive, allotriomorphic with curved grain boundaries. Pyroxene (augite) forms irregular, ragged relicts in larger grains of amphibole. Amphibole is pleochroic in brown and green and contains small relicts of pyroxene in the cores. Amphibole is probably a soda-iron type. Biotite forms anhedral, ragged, interstitial grains. Magnetite is disseminated throughout.

Reference No. 761
Sample No. WST25-20

Nepheline syenite.

Field Description. Fine grained, massive, equigranular. Colour index approximately 10%. Some pitting of weathered surface was noted. Nepheline is possibly present. Weathered and fresh surfaces are dark pinkish grey. Map unit 5d.

Petrographic Description. Medium grained, equigranular, massive, allotriomorphic with curved grain boundaries. Amphibole is strongly pleochroic in green and is likely a sodic variety. Amphibole is anhedral and partially engulfs the feldspars. Nepheline forms clear interstitial grains, with scattered, very small, highly birefringent inclusions. Plagioclase (An2-8) forms interlocking, anhedral mosaics with microcline.

Reference No. 762
Sample No. WST25-24

Syenodiorite.

Field Description. Medium grained, inequigranular-seriate, weakly trachytoidal. Colour index approximately 35%. Biotite is somewhat coarser-grained and possibly porphyroblastic. Weath-

ered surfaces are mottled buff and black, fresh surfaces mottled pale pink and black. Map unit 5n.

Petrographic Description. Fine to medium grained, equigranular, massive, allotriomorphic with curved grain boundaries. Pyroxene (augite) forms subhedral to euhedral crystals; some of the larger crystals display zoning. Rims of crystals have a slightly greener tint than core. Biotite forms large grains with irregular, anhedral outlines. Plagioclase (An 7) forms irregular, anhedral grains; some grains have ghost-like areas lacking twinning. Microcline forms anhedral, irregular grains interlocking with plagioclase.

Reference No. 763
Sample No. WST25-25

Nepheline syenite.

Field Description. Medium to coarse grained, inequigranular-seriate, trachytoidal. Phenocrysts of feldspar up to 3 cm across compose up to 40-50% of the rock. Colour index 35-40%. Weathered and fresh surfaces are bluish grey and black. Map unit 5a.

Petrographic Description. Fine to coarse grained, massive, inequigranular-seriate, allotriomorphic with curved grain boundaries. Pyroxene (aegirine-augite) forms subhedral to anhedral grains which are twinned and zoned; rims are darker green than cores. Amphibole is a dark green sodic variety with occasional relict cores of aegirine-augite. Biotite and garnet form crystal aggregates after amphibole and pyroxene. Nepheline forms clear interstitial grains with very small birefringent inclusions. Plagioclase and microcline form interlocking mosaics of anhedral crystals.

Reference No. 764
Sample No. WST25-27

Biotite syenite.

Field Description. Medium to coarse grained, weakly trachytoidal, equigranular. Colour index approximately 20%. Weathered and fresh surfaces are pinkish grey and black. Map unit 5b.

Petrographic Description. Fine to coarse grained, massive, inequigranular-seriate, allotriomorphic with curved grain boundaries. Zircon with radioactive haloes forms small inclusions in biotite. Euhedral sphene displays a parting. Biotite forms very fine-grained aggregates and coarser-grained clots with garnet. Biotite and garnet are probably after a primary mafic mineral. Microcline is a crude string perthite and forms an interlocking mosaic of anhedral grains with plagioclase (An2-8).

Reference No. 765
Sample No. WST25-29

Nepheline syenite.

Field Description. Medium to coarse grained, massive, inequigranular-seriate. Colour index approximately 10%. Weathered and fresh surfaces are mottled buff and grey with black flecks. Map unit 5b.

Petrographic Description. Fine to coarse grained, massive, inequigranular-seriate, allotriomorphic with curved grain boundaries. Nepheline forms irrregular grains with abundant inclusions which are partially oriented. Inclusions are of potassium feldspar, sericite and tourmaline(?). Plagioclase (An7?) forms interlocking mosaics of anhedral grains with microcline.

Reference No. 766
Sample No. WST25-44

Syenodiorite.

Field Description. Medium to coarse grained, weakly banded, inequigranular-seriate. Outcrop is cut by fine-grained aplite and coarse grained syenitic dikes. Weathered surfaces are mottled buff and black, fresh surfaces pale pink and black. Banding is due to slight variation in mafic-felsic ratios. Sample is texturally and compositionally homogeneous. Map unit 5p.

Petrographic Description. Medium to coarse grained, massive, equigranular, allotriomorphic with curved grain boundaries. Pyroxene forms clear fresh grains with subhedral outlines. Biotite forms booklets in distinct clusters and in association with pyroxene. Plagioclase (An10) forms interlocking mosaics of anhedral grains. Minor interstitial grains of microcline are present. Possibly some recrystallization has occurred.

Reference No. 767
Sample No. WST25-52

Syenodiorite.

Field Description. Medium to coarse grained, massive, inequigranular-seriate. Colour index approximately 25%. Fresh and weathered surfaces are mottled pink and grey with black. Map unit 5a.

Petrographic Description. Medium grained, equigranular, massive, allotriomorphic with curved grain boundaries. Plagioclase (An3-8) forms irregular, anhedral, interlocking mosaics marginal to, and partially engulfed by, larger microcline grains. Microcline has a crude stringy perthite texture. Pyroxene (augite) forms anhedral to subhedral, colourless grains. Biotite forms large books, in part, altering from and enclosing pyroxene.

Reference No. 768
Sample No. WST25-53

Syenodiorite.

Field Description. Medium grained, equigranular, massive. Weathered and fresh surfaces are mottled pink and black. Colour index approximately 40%. Map unit 5j.

Petrographic Description. Medium grained, equigranular, massive, allotriomorphic, with curved grain boundaries. Quartz occurs as interstitial grains with wavy extinction. Amphibole forms anhedral, irregular grains pleochroic in green and brown; it is a sodium-iron variety. Biotite forms anhedral aggregates sometimes in association with amphibole. Plagioclase (An2-7) forms interlocking mosaics of anhedral grains.

Reference No. 769
Sample No. WST25-60

Nepheline syenodiorite.

Field Description. Medium grained, equigranular, massive. Colour index approximately 45%. Weathered and fresh surfaces are mottled grey and black. Map unit 5j.

Petrographic Description. Medium grained, equigranular, allotriomorphic with curved grain boundaries. Sphene occurs as euhedral crystals. Nepheline forms anhedral, clear, interstitial grains. Pyroxene (augite to aegirine-augite) forms subhedral to anhedral grains mantled with deep green amphibole. Large crystals display zoning from pale colourless cores to very pale green rims. Amphibole is dark green, pleochroic, anhedral and forms isolated grains and clots. Amphibole is a sodic variety. Biotite forms books and aggregates in association with amphibole. Microcline forms anhedral to subhedral grains locally forming interlocking mosaics with plagioclase.

Reference No. 770
Sample No. WST25-70

Cancrinite syenite.

Field Description. Medium to coarse grained, inequigranular-seriate, weakly trachytoidal. Colour index 10%. Weathered and fresh surfaces are pinkish buff with black flecks. Map unit 5b.

Petrographic Description. Fine to coarse grained, massive, inequigranular-seriate, allotriomorphic with curved grain boundaries. Plagioclase (An2-11) forms interlocking mosaics with microcline perthite. Perthite is crudely stringy. Potassium feldspar replacement occurs in larger plagioclase grains. Cancrinite forms clear interstitial grains. Garnet and biotite form fine-grained, interlocking crystal aggregates, presumably after a former mafic mineral.

Reference No. 370
Sample No. WSQ6-2

Leucocratic syenite.

Field Description. Medium grained, massive, inequigranular-seriate, leucocratic, homogeneous. Weathered and fresh surfaces are white. Map unit 6b.

Petrographic Description. Medium grained, inequigranular-seriate, allotriomorphic. Biotite is after pyroxene. Calcite is interstitial to potassium feldspar. Potassium feldspar is made up of perthite, anti-perthite and microcline with irregular grain boundaries. Anhedral nepheline was noted.

Reference No. 371
Sample No. WSQ6-4

Leucocratic syenite.

Field Description. Medium grained, porphyritic, inhomogeneous, leucocratic. Feldspar phenocrysts are 1 cm across. The outcrop is cut by small 2 cm dikes of the same composition. Weathered surfaces are brown, fresh surfaces grey. Map unit 6b.

Petrographic Description. Medium grained, porphyritic, inequigranular-seriate, allotriomorphic. Calcite is interstitial between the feldspars. Garnet is grossularite in association with biotite. Perthite displays irregular crystal boundaries. Fine grained potassium feldspar crystals are found between the perthite crystal margins. Scapolite appears as fibrous crystals and is interstitial to the feldspar.

Reference No. 372
Sample No. WSQ6-5

Leucocratic syenite.

Field Description. Medium to coarse grained, leucocratic, trachytoidal, porphyritic. Feldspar phenocrysts are 2 cm across. Weathered and fresh surfaces are white. Map unit 6b.

Petrographic Description. Coarse grained, massive, inequigranular-seriate. Potassium feldspars have irregular grain boundaries. Biotite is an alteration after pyroxene (augite ?). Calcite appears as large crystals and as fillings along feldspar grain boundaries and internal fractures.

Reference No. 373
Sample No. WSQ6-6

Syenite.

Field Description. Medium grained, homogeneous, trachytoidal, porphyritic-inequigranular. Feldspar phenocrysts are up to 1 cm. Weathered surfaces are pink, fresh surfaces white. Map unit 6b.

Petrographic Description. Medium grained, massive, inequigranular-seriate, allotriomorphic. Amphibole is altered to biotite and garnet (grossularite). Rounded opaques are sulphides. Zeolites are after nepheline.

Reference No. 374
Sample No. WSQ6-8

Nepheline syenite.

Field Description. Coarse grained, inequigranular, porphyritic. Potassium feldspar phenocrysts are 0.5 cm across. Nepheline is indicated on weathered surface by pitting. Weathered and fresh surfaces are mottled salt and pepper. Map unit 6b.

Petrographic Description. Coarse grained, inequigranular-porphyritic, homogeneous. Perthite phenocrysts up to 0.5 cm across are subhedral. Biotite is after aegirine-augite. Aegirine-augite contains inclusions of both biotite and calcite. Nepheline is euhedral in small grains. In larger grains nepheline is anhedral with irregular boundaries.

Reference No. 375
Sample No. SQW-2

Leucocratic syenite.

Field Description. Medium to coarse grained, massive, porphyritic-inequigranular, leucocratic. Feldspar phenocrysts are 2-3 cm across. Weathered and fresh surfaces are red. Map unit 6b.

Petrographic Description. Medium to coarse grained, massive, inequigranular-seriate, allotriomorphic. Calcite is interstitial to the feldspars. Iddingsite is after olivine. Fine grained quartz fills fractures. Perthite and microcline have irregular grain boundaries. Perthite is patchy from potassium feldspar replacement of plagioclase and displays undulatory extinction.

Reference No. 376
Sample No. SQW-3A

Leucocratic nepheline syenite.

Field Description. Medium grained, leucocratic, massive, inequigranular-seriate, homogenous. Weathered and fresh surfaces are white. Map unit 6b.

Petrographic Description. Medium grained, massive, inequigranular–seriate, allotriomorphic. Calcite is interstitial. Sericite alteration is after perthite. Opaques appear to be sulphides i.e. pyrite, and are often associated with biotite. Sphene is randomly distributed throughout the thin section. Nepheline is subhedral.

Reference No. 377
Sample No. SQW-3B

Leucocratic syenite.

Field Description. Coarse grained, massive, inequigranular, leucocratic. Weathered and fresh surfaces are white. Map unit 6b.

Petrographic Description. Coarse grained, massive, inequigranular–seriate, allotriomorphic. Opaques are pyrite. Calcite occurs along crystal boundaries. Larger biotite laths are fractured and fractures filled with sulphides and plagioclase(?). Perthite has irregular grain boundaries, is patchy, and has undulatory extinction. Patchy perthite has resulted from the replacement of plagioclase by potassium feldspar.

Reference No. 378
Sample No. SQW-4

Leucocratic syenite.

Field Description. Coarse grained, homogeneous, weakly trachytoidal, inequigranular–seriate, leucocratic. Feldspar phenocrysts are 2–4 cm across. Weathered surfaces are white, fresh surfaces pink. Map unit 6b.

Petrographic Description. Coarse grained, massive, inequigranular–seriate, allotriomorphic. Calcite fills minor fractures. Traces of iddingsite? occur in anhedral masses. Perthite + orthoclase have irregular grain boundaries and undulatory extinction. Biotite and opaques are present in minor amounts.

Reference No. 379
Sample No. SQW-7

Nepheline syenite.

Field Description. Fine to coarse grained, homogeneous, inequigranular. Weathered surfaces are buff, fresh surfaces salt and pepper. Map unit 6b.

Petrographic Description. Fine to medium grained, porphyritic–inequigranular–seriate, allotriomorphic. Perthite and microcline phenocrysts are set in a sericite–rich groundmass. Sericite is secondary after nepheline. Biotite is an anhedral alteration after pyroxene. Calcite is interstitial to the feldspars. Perthite is patchy, has irregular grain boundaries and displays undulatory extinction. Cancrinite may also be present.

Reference No. 380
Sample No. SQW-9

Leucocratic syenite.

Field Description. Medium to coarse grained, leucocratic, homogeneous, inequigranular. Weathered surfaces are dark grey, fresh surfaces white–cream. Map unit 6b.

Petrographic Description. Coarse grained, inequigranular–seriate, allotriomorphic. Opaques have cubic outline and are probably pyrite. Biotite is after epidote. Potassium feldspar displays irregular grain boundaries. Perthite is patchy with undulatory extinction. Patchy texture is due to replacement of plagioclase by potassium feldspar.

Reference No. 383
Sample No. SQW-12

Syenodiorite.

Field Description. Medium grained, massive, equigranular, locally inequigranular–seriate, homogeneous. Weathered surfaces are grey, fresh surfaces pink. Map unit 6d.

Petrographic Description. Medium grained, massive, inequigranular–seriate, allotriomorphic. Amphibole and biotite are after pyroxene. Sphene is associated with, and is found as inclusions in, the amphibole (actinolite). Sericite is an alteration product of the plagioclase. Potassium feldspar is anhedral and displays irregular grain boundaries.

Reference No. 384
Sample No. SQW-21

Syenodiorite.

Field Description. Medium grained, massive, equigranular. Weathered and fresh surfaces are pink. The outcrop contains mafic xenoliths. Xenoliths were removed from the analyzed sample. Map unit 6g.

Petrographic Description. Medium grained, homogeneous, equigranular. Biotite contains inclusions of zircon with radioactive bombardment haloes. Sphene, both as smaller euhedral crystals and as larger anhedral crystals, occurs with euhedral grossularite. Plagioclase is subhedral with most of the cores altered to sericite. Orthoclase occurs as anhedral crystals.

Reference No. 385
Sample No. SQW-22

Quartz monzonite.

Field Description. Fine grained, massive, homogeneous, equigranular. Weathered and fresh surfaces are pink. Map unit 6g.

Petrographic Description. Fine grained, massive, homogeneous, allotriomorphic, equigranular. Sphene is euhedral and evenly distributed. Garnet occurs as rounded grains, and is possibly grossularite. Calcite is interstitial to biotite after pyroxene. Opaques are sulphides and are associated with quartz. Quartz is interstitial to the perthite. Perthite has irregular grain boundaries, is patchy, and displays undulatory extinction. Patch perthite is due to replacement of plagioclase by potassium feldspar.

TABLE A-2. MAJOR ELEMENT ANALYSES (WEIGHT PERCENT) OF WHOLE-ROCK SAMPLES FROM THE STURGEON NARROWS AND SQUAW LAKE ALKALIC ROCK COMPLEXES.

	Unit 5a						
Ref. No.	677	678	680	681	682	679	683
SiO_2	56.10	55.00	53.50	55.10	55.80	53.30	54.50
Al_2O_3	16.30	19.10	20.20	18.80	19.40	18.40	20.10
Fe_2O_3	2.82	2.35	2.06	2.86	2.53	1.31	3.03
FeO	6.65	1.66	1.33	1.33	0.83	2.91	0.66
MgO	0.85	1.54	0.61	1.42	1.00	1.92	0.70
CaO	3.88	3.07	1.76	3.39	2.98	3.37	2.30
Na_2O	4.74	7.23	9.13	6.65	7.06	6.29	8.61
K_2O	5.12	5.99	7.25	7.44	7.91	7.27	7.17
TiO_2	1.22	0.47	0.26	0.39	0.34	0.46	0.30
P_2O_5	0.37	0.24	0.05	0.21	0.18	0.28	0.13
S	0.04	0.01	0.14	0.11	0.11	0.04	0.05
MnO	0.25	0.10	0.08	0.11	0.09	0.13	0.09
CO_2	0.36	0.60	1.60	0.46	0.72	2.00	0.94
H_2O+	0.45	2.54	1.30	0.92	0.69	0.94	0.29
H_2O-	0.33	0.27	0.28	0.32	0.27	0.35	0.37
Total	99.50	100.2	99.60	99.50	99.9	99.0	99.0

	Unit 5a						
Ref. No.	684	685	686	690	689	692	694
SiO_2	53.90	54.10	53.90	50.20	54.00	52.90	54.80
Al_2O_3	20.60	20.00	20.20	21.70	20.20	20.90	17.80
Fe_2O_3	2.43	1.72	2.06	2.50	1.96	1.36	3.64
FeO	0.66	0.58	0.33	1.08	0.42	1.16	1.16
MgO	0.90	0.58	0.33	0.51	0.10	0.53	1.62
CaO	2.60	2.07	1.42	3.60	1.10	1.47	4.01
Na_2O	7.79	8.30	9.54	10.30	10.20	10.50	7.38
K_2O	8.12	8.23	7.11	6.49	6.86	6.49	6.00
TiO_2	0.28	0.41	0.24	0.57	0.17	0.43	0.58
P_2O_5	0.16	0.12	0.12	0.15	0.05	0.10	0.26
S	0.11	0.15	0.30	0.26	0.76	0.23	0.14
MnO	0.07	0.06	0.05	0.09	0.05	0.07	0.12
CO_2	0.48	1.44	0.96	0.52	1.44	1.70	0.64
H_2O+	0.68	0.82	1.13	0.65	1.22	1.54	0.94
H_2O-	0.34	0.40	0.43	0.24	0.22	0.22	0.31
Total	99.1	99.0	98.1	98.9	98.8	99.6	99.4

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Ref. No.	Sample No.	Ref. No.	Sample No.
677	STR4-20	684	STR11-15B
678	STR4-23	685	STR11-16C
680	STR11-8A	686	STR11-19A
681	STR11-8B	690	STR16-8
682	STR11-9	689	STR16-6B
679	STR11-7A	692	STR16-18
683	STR11-11	694	STR17-3

TABLE A-2. CONTINUED

	Unit 5a						
Ref. No.	**695**	**696**	**697**	**698**	**717**	**718**	**719**
SiO_2	55.30	55.40	56.10	58.90	54.50	54.30	61.40
Al_2O_3	18.40	18.40	20.80	18.10	17.90	18.40	18.60
Fe_2O_3	2.62	2.34	1.60	2.17	3.23	2.77	1.33
FeO	1.83	1.41	1.16	0.58	1.83	1.75	1.25
MgO	1.80	1.66	0.85	1.00	1.87	2.12	0.44
CaO	3.67	3.10	2.50	2.68	4.04	3.96	1.50
Na_2O	6.69	7.68	5.73	5.19	5.77	6.71	6.14
K_2O	6.23	5.82	6.86	8.55	7.07	5.76	7.05
TiO_2	0.52	0.70	0.33	0.10	0.57	0.60	0.27
P_2O_5	0.25	0.29	0.14	0.16	0.31	0.30	0.12
S	0.10	0.19	0.04	0.06	0.13	0.17	0.01
MnO	0.12	0.10	0.07	0.10	0.15	0.11	0.06
CO_2	0.36	0.32	0.36	0.26	0.72	0.26	0.48
H_2O+	1.03	0.70	1.32	0.27	0.66	0.69	0.09
H_2O-	0.32	0.29	0.43	0.37	0.40	0.39	0.34
Total	99.2	98.1	98.3	98.5	99.2	98.3	99.1

	Unit 5a						
Ref. No.	**720**	**721**	**722**	**723**	**724**	**727**	**728**
SiO_2	61.70	56.70	58.30	57.00	55.10	55.60	55.80
Al_2O_3	18.40	20.90	20.50	21.10	18.10	19.20	18.10
Fe_2O_3	1.84	2.35	1.65	1.53	2.62	2.32	3.01
FeO	1.25	0.83	1.50	1.25	2.74	1.50	1.58
MgO	0.54	1.17	1.06	1.14	2.41	1.72	2.17
CaO	1.47	2.98	2.32	2.74	3.74	3.21	4.34
Na_2O	5.99	6.28	5.51	6.56	4.85	7.50	5.85
K_2O	6.98	6.51	6.23	6.60	6.53	5.66	5.58
TiO_2	0.28	0.34	0.43	0.58	0.61	0.49	0.55
P_2O_5	0.11	0.18	0.17	0.16	0.35	0.25	0.28
S	0.01	0.01	0.05	0.43	0.02	0.14	0.05
MnO	0.08	0.08	0.08	0.07	0.13	0.09	0.10
CO_2	0.56	0.26	0.16	0.72	0.32	0.20	0.16
H_2O+	0.25	0.98	0.38	0.93	0.57	0.55	1.00
H_2O-	0.33	0.42	0.37	0.48	0.38	0.40	0.36
Total	99.8	100.0	99.4	101.3	98.5	98.8	98.9

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Ref. No.	Sample No.	Ref. No.	Sample No.
695	STR17-5	720	STR18-59
696	STR17-7	721	STR19-1
697	STR17-8	722	STR19-2
698	STR17-9	723	STR19-5
717	STR18-48	724	STR19--9
718	STR18-52	727	STR19-14A
719	STR18-58	728	STR19-15

TABLE A-2. CONTINUED

	Unit 5a						
Ref. No.	729	734	735	732	736	743	746
SiO_2	55.80	62.00	55.00	46.00	49.70	53.10	56.50
Al_2O_3	18.30	18.50	20.50	13.00	18.60	18.10	19.20
Fe_2O_3	2.83	1.67	1.53	9.13	2.94	3.63	1.51
FeO	1.41	0.91	1.33	1.33	1.16	1.25	2.83
MgO	1.94	0.73	0.39	1.53	0.86	2.14	1.91
CaO	3.60	1.97	1.29	11.90	6.01	5.32	3.58
Na_2O	7.05	5.43	8.83	6.62	10.30	7.15	4.81
K_2O	6.04	7.28	6.58	3.81	4.89	5.40	6.25
TiO_2	0.54	0.35	0.40	1.94	0.18	0.69	0.68
P_2O_5	0.27	0.14	0.09	0.46	0.51	0.36	0.38
S	0.20	0.08	0.25	0.63	0.31	0.22	0.04
MnO	0.12	0.07	0.10	0.23	0.14	0.13	0.08
CO_2	0.26	0.20	0.40	0.84	0.96	1.20	0.24
H_2O+	0.93	0.19	0.89	0.80	1.14	0.60	0.54
H_2O-	0.25	0.38	0.38	0.34	0.38	0.48	0.46
Total	99.6	99.9	98.0	98.6	98.1	99.8	98.9

	Unit 5a						
Ref. No.	747	748	752	763	767	665	666
SiO_2	52.40	56.30	61.90	52.20	60.60	56.20	54.90
Al_2O_3	14.60	15.90	18.60	17.20	17.60	22.00	19.90
Fe_2O_3	5.24	1.91	1.85	3.70	2.90	1.82	1.96
FeO	7.32	4.65	1.16	3.24	0.91	0.58	1.25
MgO	3.84	3.96	1.11	2.27	1.77	0.51	0.95
CaO	7.89	5.30	2.05	5.81	2.66	1.77	2.25
Na_2O	3.34	4.64	6.71	5.62	6.29	4.10	6.82
K_2O	5.83	4.74	5.28	6.07	5.21	8.16	7.17
TiO_2	0.86	0.72	0.35	0.93	0.36	0.39	0.46
P_2O_5	0.58	0.41	0.18	0.47	0.26	0.10	0.15
S	0.03	0.01	0.07	0.09	0.01	0.02	0.08
MnO	0.19	0.13	0.06	0.17	0.08	0.06	0.09
CO_2	0.18	0.16	0.20	0.19	0.12	1.26	0.82
H_2O+	0.67	0.25	0.15	0.74	0.13	1.05	1.83
H_2O-	0.45	0.42	0.38	0.38	0.34	0.38	0.35
Total	99.4	99.5	100.1	99.1	99.2	98.4	99.0

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Ref. No.	Sample No.	Ref. No.	Sample No.
729	STR19-16	747	WST20-3
734	WST14-6	748	WST20-5
735	WST14-17	752	WST20-14
732	WST13-1	763	WST25-25
736	WST18-3	767	WST25-52
743	WST18-20	665	STR2-15
746	WST20-2	666	STR2-18

TABLE A-2. CONTINUED

	Unit 5a						
Ref. No.	**668**	**669**	**670**	**671**	**672**	**673**	**676**
SiO_2	54.10	54.70	55.00	53.30	55.40	53.30	51.60
Al_2O_3	20.20	19.80	18.50	20.50	21.50	22.20	17.00
Fe_2O_3	2.22	0.98	1.36	1.17	1.19	1.24	3.53
FeO	1.33	2.08	2.41	1.41	1.25	0.83	2.74
MgO	1.13	1.07	1.78	0.62	0.48	0.29	3.37
CaO	2.51	2.70	3.07	2.10	1.99	1.50	6.24
Na_2O	7.89	6.22	7.10	9.22	5.41	9.96	6.32
K_2O	6.18	7.09	5.95	6.59	7.90	6.43	4.74
TiO_2	0.48	0.38	0.49	0.34	0.27	0.39	0.60
P_2O_5	0.18	0.18	0.26	0.12	0.10	0.08	0.53
S	0.10	0.15	0.22	0.33	0.06	0.12	0.14
MnO	0.09	0.09	0.13	0.09	0.06	0.06	0.13
CO_2	0.61	1.37	1.30	1.24	1.53	0.78	0.18
H_2O+	2.17	1.66	0.99	1.31	1.40	1.31	0.57
H_2O-	0.36	0.40	0.44	0.42	0.44	0.35	0.35
Total	99.6	98.9	99.0	98.8	99.0	98.8	98.0

	Unit 5a	Unit 5b					
Ref. No.	**730**	**687**	**688**	**691**	**693**	**674**	**675**
SiO_2	54.30	55.20	55.20	53.40	51.90	53.00	53.90
Al_2O_3	19.00	20.20	19.20	20.50	23.20	17.30	20.20
Fe_2O_3	3.33	1.44	2.07	1.35	0.81	3.25	1.54
FeO	0.91	0.42	0.33	1.33	0.75	2.74	1.33
MgO	1.61	0.13	0.15	0.37	0.27	3.18	0.65
CaO	4.81	1.43	1.74	1.36	1.53	5.80	1.78
Na_2O	6.19	10.70	9.13	9.37	11.10	6.36	9.75
K_2O	6.19	6.22	7.08	7.06	6.46	5.10	5.96
TiO_2	0.42	0.26	0.14	0.36	0.43	0.58	0.40
P_2O_5	0.28	0.05	0.26	0.09	0.08	0.51	0.11
S	0.04	0.40	0.58	0.11	0.26	0.11	0.41
MnO	0.12	0.04	0.07	0.08	0.04	0.13	0.11
CO_2	0.12	0.58	1.50	2.04	0.46	0.26	0.64
H_2O+	1.30	0.95	1.03	1.48	1.17	0.57	0.63
H_2O-	0.38	0.27	0.31	0.23	0.24	0.30	0.44
Total	99.0	98.3	98.8	99.1	98.4	99.2	97.9

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Ref. No.	Sample No.	Ref. No.	Sample No.
668	STR2-31	730	STR19-18
669	STR2-35	687	STR16-2
670	STR2-39	688	STR16-3
671	STR4-1	691	STR16-13
672	STR4-3	693	STR17-2A
673	STR4-10	674	STR4-12
676	STR4-13C	675	STR4-13B

TABLE A-2. CONTINUED

	Unit 5b						
Ref. No.	733	740	754	755	764	765	770
SiO_2	55.20	62.80	56.60	54.70	57.10	56.70	53.50
Al_2O_3	16.50	18.40	21.80	19.90	20.60	23.50	21.50
Fe_2O_3	4.13	1.08	1.57	1.79	1.69	0.21	1.04
FeO	0.75	0.25	0.66	0.91	1.16	0.50	0.42
MgO	1.50	0.15	0.40	0.52	1.06	0.12	0.33
CaO	5.05	0.94	1.19	2.03	2.80	0.88	2.27
Na_2O	7.08	6.77	8.31	9.02	4.70	10.80	9.44
K_2O	5.80	7.27	7.60	6.51	7.38	5.40	7.33
TiO_2	0.72	0.22	0.40	0.31	0.38	0.04	0.22
P_2O_5	0.25	0.04	0.08	0.09	0.14	0.03	0.10
S	0.27	0.01	0.06	0.21	0.03	0.01	0.28
MnO	0.15	0.04	0.06	0.08	0.09	0.02	0.04
CO_2	0.86	0.22	0.50	0.76	0.38	0.15	0.99
H_2O+	0.56	0.44	0.79	1.13	2.01	0.43	1.09
H_2O-	0.28	0.28	0.51	0.36	0.36	0.35	0.47
Total	99.1	98.9	100.5	98.3	99.9	99.1	99.0

	Unit 5c						
Ref. No.	699	701	700	702	703	704	705
SiO_2	58.40	57.60	56.20	57.70	60.60	54.60	57.70
Al_2O_3	17.10	18.70	20.40	19.40	18.90	15.50	18.50
Fe_2O_3	3.81	2.34	1.52	1.67	1.87	4.07	2.57
FeO	0.75	0.25	0.25	0.42	0.33	2.49	0.33
MgO	0.69	0.19	0.14	0.12	0.19	3.89	0.21
CaO	3.07	2.45	1.61	2.12	2.07	5.59	2.74
Na_2O	6.95	7.98	10.60	8.20	7.27	5.93	8.29
K_2O	6.27	6.77	5.74	7.07	6.54	4.52	6.38
TiO_2	0.39	0.24	0.14	0.18	0.35	0.95	0.32
P_2O_5	0.19	0.08	0.06	0.06	0.07	0.58	0.07
S	0.25	0.38	0.68	0.44	0.08	<0.01	0.38
MnO	0.11	0.08	0.04	0.05	0.06	0.10	0.07
CO_2	0.30	0.66	0.32	0.36	0.40	0.16	0.30
H_2O+	0.44	0.81	1.34	0.85	1.00	0.64	0.59
H_2O-	0.32	0.27	0.34	0.35	0.38	0.25	0.28
Total	99.0	98.8	99.4	99.0	99.7	99.0	98.7

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Ref. No.	Sample No.	Ref. No.	Sample No.
733	WST14-1	699	STR18-33A
740	WST18-8B	701	STR18-34A
754	WST23-3	700	STR18-33B
755	WST23-8	702	STR18-35
764	WST25-27	703	STR18-36
765	WST25-29	704	STR18-37B
770	WST25-70	705	STR18-38

TABLE A-2. CONTINUED

	Unit 5c						
Ref. No.	706	707	708	709	710	711	712
SiO_2	56.40	58.10	64.60	57.00	56.40	59.80	63.00
Al_2O_3	15.90	21.30	17.60	15.90	16.30	18.50	19.00
Fe_2O_3	2.75	1.45	1.71	4.32	3.98	2.50	0.99
FeO	1.16	0.33	0.25	0.91	1.25	0.50	0.33
MgO	2.26	0.16	0.42	1.35	2.94	0.65	0.19
CaO	3.93	0.75	1.34	4.45	5.47	1.98	1.15
Na_2O	6.87	8.91	6.95	7.09	6.13	7.56	8.66
K_2O	6.41	7.15	6.33	5.44	4.76	6.43	5.02
TiO_2	0.63	0.12	0.09	0.39	0.68	0.17	0.18
P_2O_5	0.46	0.05	0.07	0.23	0.53	0.11	0.05
S	0.40	0.02	0.01	0.15	0.12	0.16	0.09
MnO	0.08	0.04	0.07	0.19	0.10	0.10	0.04
CO_2	0.24	0.16	0.16	0.30	0.24	0.24	0.24
H_2O+	0.53	0.20	0.21	0.38	0.77	0.45	0.40
H_2O-	0.27	0.28	0.26	0.19	0.22	0.22	0.16
Total	98.3	99.0	100.1	98.3	99.9	99.4	99.5

	Unit 5c						
Ref. No.	713	716	715	738	741	742	726
SiO_2	63.10	63.80	58.40	57.30	56.00	63.00	59.20
Al_2O_3	18.80	18.20	16.70	20.10	19.90	18.60	19.10
Fe_2O_3	1.07	1.13	3.06	1.42	1.71	1.06	1.99
FeO	0.33	0.33	1.33	0.75	0.33	0.66	1.41
MgO	0.16	0.18	2.39	0.08	0.13	0.30	0.98
CaO	0.89	0.90	4.09	1.30	1.92	0.93	2.39
Na_2O	7.81	7.31	6.68	8.61	9.17	4.84	5.56
K_2O	5.72	6.06	4.40	6.53	6.88	8.59	6.89
TiO_2	0.16	0.22	0.61	0.19	0.23	0.17	0.38
P_2O_5	0.06	0.06	0.34	0.05	0.08	0.07	0.18
S	0.02	0.02	0.05	0.07	0.46	0.01	0.01
MnO	0.04	0.05	0.08	0.05	0.08	0.04	0.08
CO_2	0.20	0.16	0.18	0.96	0.60	0.30	0.28
H_2O+	0.65	0.16	0.09	0.81	0.83	0.10	0.75
H_2O-	0.19	0.32	0.37	0.28	0.30	0.35	0.32
Total	99.2	98.2	98.8	98.5	98.6	99.0	99.5

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Ref. No.	Sample No.	Ref. No.	Sample No.
706	STR18-39	713	STR18-45
707	STR18-40A	716	STR18-46C
708	STR18-40B	715	STR18-46B
709	STR18-41A	738	WST18-7B
710	STR18-41B	741	WST18-10
711	STR18-41C	742	WST18-18
712	STR18-44	726	STR19-12

TABLE A-2. CONTINUED

	Unit 5d				Unit 5n		Unit 5j,p
Ref. No.	737	739	744	761	757	762	725
SiO_2	62.10	64.70	61.70	55.30	56.20	56.60	56.20
Al_2O_3	17.60	18.20	17.10	22.50	16.30	16.50	16.20
Fe_2O_3	1.99	1.25	2.87	1.44	2.18	1.97	2.71
FeO	0.58	0.42	0.66	1.08	3.74	4.40	3.74
MgO	0.96	0.26	0.96	0.24	4.41	3.80	3.79
CaO	2.01	1.08	2.70	1.44	5.43	5.10	4.90
Na_2O	7.36	7.55	6.53	8.57	5.61	4.74	4.56
K_2O	5.69	5.86	5.32	7.40	3.62	4.96	4.88
TiO_2	0.30	0.24	0.48	0.32	0.74	0.67	0.65
P_2O_5	0.15	0.07	0.21	0.06	0.46	0.39	0.38
S	0.09	0.01	0.02	0.05	0.01	0.01	0.01
MnO	0.06	0.05	0.07	0.06	0.11	0.13	0.12
CO_2	0.16	0.18	0.16	0.31	0.20	0.10	0.18
H_2O+	0.18	0.33	1.44	0.07	0.42	0.23	0.47
H_2O-	0.30	0.24	0.38	0.30	0.37	0.36	0.37
Total	99.5	100.4	100.6	99.1	99.8	100.0	99.2

	Unit 5j,p						
Ref. No.	667	731B	745	749	750	751	758
SiO_2	56.60	57.70	56.60	56.40	59.90	55.60	55.00
Al_2O_3	17.60	17.20	15.90	16.20	18.00	16.70	16.40
Fe_2O_3	3.76	2.51	3.02	2.10	2.51	3.40	3.73
FeO	2.49	3.16	3.24	4.24	1.83	3.08	2.91
MgO	2.52	3.43	3.38	3.82	1.95	3.54	3.81
CaO	4.29	5.05	4.84	5.00	2.95	5.54	5.22
Na_2O	5.86	5.52	5.27	4.87	6.27	5.26	5.66
K_2O	4.27	3.05	4.61	4.93	4.33	4.12	4.25
TiO_2	0.61	0.64	0.62	0.66	0.48	0.66	0.69
P_2O_5	0.36	0.32	0.38	0.39	0.21	0.49	0.50
S	0.01	0.01	0.01	0.01	0.02	0.01	0.01
MnO	0.13	0.11	0.13	0.13	0.10	0.12	0.13
CO_2	0.08	0.16	0.20	0.12	0.20	0.20	0.18
H_2O+	0.39	0.28	0.16	0.22	0.42	0.24	0.34
H_2O-	0.35	0.38	0.42	0.42	0.44	0.34	0.38
Total	99.3	99.5	98.8	99.5	99.6	99.3	99.2

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Ref. No.	Sample No.	Ref. No.	Sample No.
737	WST18-4A	667	STR2-30
739	WST18-8A	731B	STR26-4
744	WST18-21	745	WST18-25
761	WST25-20	749	WST20-6
757	WST25-7	750	WST20-11
762	WST25-24	751	WST20-13
725	STR19-11	758	WST25-8B

TABLE A-2. CONTINUED

	Unit 5j,p						
Ref. No.	756	759	760	768	769	766	731A
SiO_2	54.30	55.20	55.70	60.10	50.90	57.50	56.90
Al_2O_3	16.40	16.50	17.30	17.10	15.70	17.30	17.40
Fe_2O_3	2.97	3.48	5.49	2.47	4.05	2.73	2.28
FeO	3.82	3.41	1.81	2.66	4.74	2.74	3.16
MgO	4.14	4.60	3.32	2.84	4.00	2.79	3.39
CaO	6.00	5.74	4.50	4.02	7.58	4.22	4.95
Na_2O	4.92	5.47	5.29	5.46	5.06	6.21	5.64
K_2O	4.35	2.79	4.03	3.18	5.14	3.95	3.16
TiO_2	0.77	0.82	0.67	0.53	0.90	0.76	0.51
P_2O_5	0.56	0.47	0.40	0.31	0.71	0.53	0.33
S	0.01	0.01	0.04	0.02	0.18	0.01	0.01
MnO	0.13	0.12	0.14	0.10	0.17	0.09	0.11
CO_2	0.18	0.14	0.18	0.14	0.10	0.10	0.16
H_2O+	0.23	0.30	0.58	0.55	0.51	0.33	0.39
H_2O-	0.34	0.82	0.39	0.32	0.40	0.35	0.34
Total	99.1	99.9	99.8	99.8	100.1	99.6	98.7

	Unit 6b						
Ref. No.	378	379	375	376	377	380	370
SiO_2	56.60	52.60	59.40	57.00	60.40	58.00	60.40
Al_2O_3	17.30	18.80	18.80	18.80	18.60	19.40	19.20
Fe_2O_3	0.97	2.60	1.46	1.01	1.41	1.90	0.87
FeO	1.66	2.58	0.83	1.08	1.08	1.66	1.25
MgO	0.84	0.81	0.30	0.25	0.39	0.24	0.34
CaO	4.14	3.15	2.41	2.49	1.66	1.08	0.66
Na_2O	4.66	6.17	6.10	7.99	5.92	7.33	6.36
K_2O	8.02	7.85	6.47	6.43	6.83	7.13	8.34
TiO_2	0.54	0.50	0.43	0.36	0.51	0.34	0.36
P_2O_5	0.22	0.35	0.06	0.09	0.08	0.03	0.06
S	0.06	0.18	0.03	0.32	0.03	0.09	0.02
MnO	0.06	0.09	0.06	0.04	0.04	0.07	0.03
CO_2	3.06	1.90	1.48	1.98	0.64	0.80	0.50
H_2O+	0.86	1.54	1.13	0.69	0.73	0.75	0.52
H_2O-	0.26	0.34	0.33	0.31	0.37	0.30	0.24
Total	99.3	99.5	99.3	98.8	98.7	99.1	99.4

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Ref. No.	Sample No.	Ref. No.	Sample No.
756	WST25-4C	378	SQW-4
759	WST25-14	379	SQW-7
760	WST25-19	375	SQW-2
768	WST25-53	376	SQW-3A
769	WST25-60	377	SWQ-3B
766	WST25-44	380	SQW-9
731A	STR26-1	370	WSQ6-2

TABLE A-2. CONTINUED

	Unit 6b				Unit 6d	Unit 6g	
Ref. No.	371	372	373	374	383	384	385
SiO_2	61.60	53.90	57.20	50.30	60.80	58.10	65.80
Al_2O_3	17.80	19.90	19.30	21.00	17.70	18.20	17.10
Fe_2O_3	2.00	0.66	1.27	1.93	2.28	2.41	1.32
FeO	1.58	0.75	1.33	0.83	1.75	2.33	0.58
MgO	0.35	0.10	0.60	0.36	1.26	1.92	0.42
CaO	1.14	3.11	0.90	2.22	2.97	4.67	1.39
Na_2O	6.21	8.92	6.30	10.60	6.88	7.13	6.54
K_2O	6.74	7.16	9.25	6.49	3.87	2.52	6.08
TiO_2	0.40	0.13	0.28	0.27	0.53	0.65	0.31
P_2O_5	0.08	0.08	0.09	0.20	0.24	0.35	0.18
S	0.04	0.49	0.28	0.60	0.02	0.03	0.03
MnO	0.06	0.05	0.06	0.06	0.08	0.10	0.06
CO_2	0.44	3.00	0.66	1.20	0.20	0.36	0.38
H_2O+	0.13	0.74	0.72	1.41	0.31	0.19	0.25
H_2O-	0.22	0.28	0.25	0.27	0.24	0.23	0.29
Total	98.8	99.3	98.5	98.1	99.1	99.2	100.7

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Ref. No.	Sample No.	Ref. No.	Sample No.
371	WSQ6-4	383	SQW-12
372	WSQ6-5	384	SQW-21
373	WSQ6-6	385	SQW-22
374	WSQ6-8		

TABLE A-3. TRACE ELEMENT ANALYSES (PPM) OF WHOLE-ROCK SAMPLES FROM THE STURGEON NARROWS AND SQUAW LAKE ALKALIC ROCK COMPLEXES.*

	Unit 5a						
Ref. No.	677	678	680	681	682	679	683
Ag	<1	<1	<1	<1	<1	<1	<1
Au							
As							
Ba	3600	700	980	690	1200	670	540
Be	<1	8	8	8	6	10	8
Bi							
Co	9	10	7	10	8	10	8
Cr	<5	40	<5	45	30	60	25
Cu	10	20	<5	25	7	15	7
Ga	15	15	20	20	15	20	20
Hg							
Li	7	55	45	55	40	115	45
Mn							
Mo	2	<1	<1	<1	<1	<1	<1
Nb	<30	<30	<30	<30	<30	<30	<30
Ni	<5	15	<5	15	7	20	<5
Pb	<10	45	25	30	25	50	40
Rb	60	210	310	270	280	310	300
Sb							
Sc	15	5	<5	<5	<5	7	<5
Sn	<3	10	<3	<3	<3	<3	<3
Sr	300	700	700	800	1000	900	700
Ti							
V	<10	50	60	60	60	60	45
Y	20	30	<10	20	20	20	<10
Zn	105	95	85	90	60	175	95
Zr	100	300	400	250	200	700	300
La	<100	<100	<100	<100	<100	<100	<100
Nd	<100	<100	<100	<100	<100	<100	<100
Ce	190	260	100	210	90	260	110
Yb	<1	<1	<1	<1	<1	<1	<1

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

* Europium was assayed for in all samples but was never detected in quantities exceeding the limits of detection (100 ppm).

Ref. No.	Sample No.	Ref. No.	Sample No.
677	STR4-20	682	STR11-9
678	STR4-23	679	STR11-7A
680	STR11-8A	683	STR11-11
681	STR11-8B		

TABLE A-3. CONTINUED.

	Unit 5a						
Ref. No.	684	685	686	690	689	692	694
Ag	<1	<1	<1	<1	<1	<1	<1
Au							
As							
Ba	540	630	1000	1200	6800	280	620
Be	5	6	6	7	7	9	8
Bi							
Co	6	6	6	7	5	5	9
Cr	20	15	5	6	<5	15	50
Cu	55	15	6	9	10	10	15
Ga	20	15	25	20	20	20	20
Hg							
Li	30	30	20	10	20	105	40
Mn							
Mo	<1	<1	<1	<1	<1	<1	<1
Nb	<30	<30	<30	<30	<30	<30	<30
Ni	6	5	<5	<5	<5	<5	20
Pb	20	40	40	30	25	45	35
Rb	280	320	260	240	220	310	200
Sb							
Sc	<5	<5	<5	<5	<5	<5	<5
Sn	<3	<3	<3	<3	<3	<3	<3
Sr	700	800	900	700	600	600	1500
Ti							
V	40	30	40	90	30	35	90
Y	<10	15	<10	50	<10	15	20
Zn	50	55	60	65	55	70	110
Zr	100	200	150	250	250	300	300
La	<100	<100	<100	<100	<100	<100	<100
Nd	<100	<100	<100	<100	<100	<100	<100
Ce	190	170	840	230	60	180	240
Yb	<1	<1	<1	2	<1	<1	<1

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Ref. No.	Sample No.	Ref. No.	Sample No.
684	STR11-15B	689	STR16-6B
685	STR11-16C	692	STR16-18
686	STR11-19A	694	STR17-3
690	STR16-8		

TABLE A-3. CONTINUED.

	Unit 5a						
Ref. No.	**695**	**696**	**697**	**698**	**717**	**718**	**719**
Ag	<1	<1	<1	<1	<1	<1	<1
Au							
As							
Ba	660	800	580	1100	1200	370	380
Be	7	8	8	8	8	10	4
Bi							
Co	10	10	8	7	10	15	6
Cr	55	45	15	20	45	50	<5
Cu	20	15	5	6	20	15	5
Ga	20	20	15	15	15	15	15
Hg							
Li	65	55	70	80	60	50	20
Mn							
Mo	<1	<1	<1	<1	<1	<1	<1
Nb	<30	<30	<30	<30	<30	<30	<30
Ni	20	25	6	<5	20	25	<5
Pb	65	45	45	35	160	50	40
Rb	210	180	200	310	190	160	190
Sb							
Sc	<5	<5	<5	<5	6	7	<5
Sn	<3	<3	<3	<3	<3	<3	<3
Sr	1500	1000	1500	1000	1500	1000	700
Ti							
V	70	60	45	50	90	80	40
Y	30	25	20	<10	35	35	<10
Zn	115	95	75	70	145	100	55
Zr	300	600	600	150	350	350	300
La	<100	<100	<100	<100	<100	<100	<100
Nd	<100	<100	<100	<100	<100	<100	<100
Ce	260	220	170	240	360	320	120
Yb	<1	<1	<1	<1	<1	2	<1

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Ref. No.	Sample No.	Ref. No.	Sample No.
695	STR17-5	717	STR18-48
696	STR17-7	718	STR18-52
697	STR17-8	719	STR18-58
698	STR17-9		

TABLE A-3. CONTINUED.

	Unit 5a						
Ref. No.	720	721	722	723	724	727	728
Ag	<1	<1	<1	<1	<1	<1	<1
Au							
As							
Ba	280	580	600	600	990	850	790
Be	5	8	6	8	6	10	10
Bi							
Co	6	6	7	7	15	15	15
Cr	<5	30	25	25	60	40	60
Cu	<5	15	7	8	10	15	10
Ga	15	15	15	20	15	20	15
Hg							
Li	30	50	30	40	60	75	55
Mn							
Mo	<1	<1	<1	<1	<1	<1	<1
Nb	<30	<30	<30	<30	<30	<30	<30
Ni	<5	15	10	10	30	15	30
Pb	40	40	40	50	160	60	70
Rb	190	160	120	120	170	210	180
Sb							
Sc	<5	<5	<5	<5	7	<5	5
Sn	<3	<3	<3	<3	<3	<3	<3
Sr	350	1000	900	1500	1500	1000	1500
Ti							
V	25	50	50	40	80	50	70
Y	<10	20	20	20	30	20	20
Zn	65	65	70	70	150	40	105
Zr	200	200	600	250	200	300	700
La	<100	<100	<100	<100	<100	<100	150
Nd	<100	<100	<100	<100	<100	<100	<100
Ce	120	180	170	230	350	250	270
Yb	<1	<1	<1	<1	<1	<1	<1

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Ref. No.	Sample No.	Ref. No.	Sample No.
720	STR18-59	724	STR19-9
721	STR19-1	727	STR19-14A
722	STR19-2	728	STR19-15
723	STR19-5		

TABLE A-3. CONTINUED.

	Unit 5a						
Ref. No.	**729**	**734**	**735**	**732**	**736**	**743**	**746**
Ag	<1	<1	<1	<1	<1	<1	<1
Au							
As							
Ba	860	1000	200	2000	1600	1200	1900
Be	6	5	7	6	6	7	4
Bi							
Co	15	9	7	15	7	10	15
Cr	55	15	10	20	20	45	20
Cu	15	35	8	45	6	25	20
Ga	15	15	20	15	20	15	15
Hg							
[illegible]	50	20	95	70	15	25	25
Mn							
Mo	<1	<1	<1	<1	<1	<1	<1
Nb	<30	<30	<30	<30	<30	35	<30
Ni	25	7	<5	<5	5	20	8
Pb	215	50	80	30	40	40	40
Rb	160	190	210	140	180	130	130
Sb							
Sc	6	<5	<5	<5	<5	<5	<5
Sn	6	<3	<3	6	<3	<3	<3
Sr	1000	1000	500	1500	1000	1500	1500
Ti							
V	60	35	30	600	50	100	70
Y	30	20	15	150	50	40	10
Zn	110	55	150	95	100	95	75
Zr	300	150	150	700	600	250	200
La	150	<100	<100	150	350	200	100
Nd	<100	<100	<100	300	300	<100	<100
Ce	310	200	220	530	600	390	190
Yb	<1	<1	<1	10	2	1	<1

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Ref. No.	Sample No.	Ref. No.	Sample No.
729	STR19-16	736	WST18-3
734	WST14-6	743	WST18-20
735	WST14-17	746	WST20-2
732	WST13-1		

TABLE A-3. CONTINUED.

	Unit 5a						
Ref. No.	747	748	752	763	767	665	666
Ag	<1	<1	<1	<1	<1	<1	<1
Au							
As							
Ba	2200	820	1420	1340	1190	560	520
Be	8	5	2	6	3	5	6
Bi							
Co	20	20	6	8	10	8	9
Cr	75	165	15	25	50	10	25
Cu	40	35	15	25	6	10	15
Ga	10	15	15	15	15	15	15
Hg							
Li	45	20	10	20	20	130	40
Mn							
Mo	<1	<1	<1	<1	<1	<1	<1
Nb	<30	<30	<30	<30	<30	<30	<30
Ni	35	45	10	9	25	7	10
Pb	30	30	40	25	40	40	40
Rb	120	120	100	130	110	320	240
Sb							
Sc	9	15	<5	6	5	<5	<5
Sn	<3	<3	<3	<3	<3	<3	<3
Sr	1500	700	1000	1500	1800	500	500
Ti							
V	70	100	40	150	50	35	40
Y	35	25	15	40	10	15	20
Zn	140	95	70	120	80	45	75
Zr	200	200	300	300	350	200	300
La	150	<100	150	200	<100	<100	100
Nd	<100	<100	<100	<100	<100	<100	<100
Ce	400	270	290	370	200	180	260
Yb	2	<1	<1	<1	<1	<1	<1

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Ref. No.	Sample No.	Ref. No.	Sample No.
747	WST20-3	767	WST25-52
748	WST20-5	665	STR2-15
752	WST20-14	666	STR2-18
763	WST25-25		

TABLE A-3. CONTINUED.

	Unit 5a						
Ref. No.	668	669	670	671	672	673	676
Ag	<1	<1	<1	<1	<1	<1	<1
Au							
As							
Ba	520	700	760	650	420	210	1470
Be	7	7	8	10	8	8	6
Bi							
Co	9	10	10	6	5	<5	20
Cr	30	30	50	15	10	<5	65
Cu	15	15	15	10	10	8	40
Ga	15	20	20	20	20	20	15
Hg							
Li	65	110	160	70	105	60	50
Mn							
Mo	<1	<1	<1	<1	<1	<1	<1
Nb	<30	<30	<30	<30	<30	<30	<30
Ni	10	15	25	7	<5	<5	35
Pb	40	45	60	50	50	50	65
Rb	230	240	260	210	150	180	90
Sb							
Sc	<5	<5	<5	<5	<5	<5	9
Sn	<3	<3	<3	<3	<3	<3	6
Sr	600	1000	1000	800	900	600	1500
Ti							
V	60	45	90	40	35	30	100
Y	25	20	35	20	10	30	20
Zn	85	70	110	70	60	50	100
Zr	250	250	600	300	250	200	200
La	100	100	150	100	<100	<100	100
Nd	<100	<100	<100	<100	<100	<100	<100
Ce	250	210	290	230	160	220	260
Yb	<1	<1	<1	<1	<1	<1	<1

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Ref. No.	Sample No.	Ref. No.	Sample No.
668	STR2-31	672	STR4-3
669	STR2-35	673	STR4-10
670	STR2-39	676	STR4-13C
671	STR4-1		

TABLE A-3. CONTINUED.

	Unit 5a	Unit 5b					
Ref. No.	730	687	688	691	693	674	675
Ag	<1	<1	<1	<1	<1	<1	<1
Au							
As							
Ba	1120	400	1200	320	700	1300	610
Be	9	6	7	8	5	4	10
Bi							
Co	10	5	5	5	5	20	8
Cr	35	<5	<5	6	<5	60	15
Cu	45	15	6	6	15	40	10
Ga	20	20	25	20	25	15	20
Hg							
Li	70	15	6	95	55	40	30
Mn							
Mo	<1	<1	<1	<1	<1	<1	<1
Nb	<30	<30	<30	<30	<30	<30	<30
Ni	10	<5	<5	<5	<5	35	7
Pb	45	30	25	45	25	30	60
Rb	220	190	200	360	280	120	180
Sb							
Sc	<5	<5	<5	<5	6	18	<5
Sn	<3	<3	<3	<3	<3	<3	<3
Sr	1000	800	900	450	800	1000	700
Ti							
V	70	15	30	20	25	100	40
Y	25	<10	<10	<10	<10	30	30
Zn	100	45	65	130	35	100	95
Zr	350	250	250	600	100	150	600
La	150	<100	<100	<100	<100	100	150
Nd	<100	<100	<100	<100	<100	<100	<100
Ce	330	150	200	80	130	370	310
Yb	<1	<1	<1	<1	<1	<1	<1

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Ref. No.	Sample No.	Ref. No.	Sample No.
730	STR19-18	693	STR17-2A
687	STR16-2	674	STR4-12
688	STR16-3	675	STR4-13B
691	STR16-13		

TABLE A-3. CONTINUED.

	Unit 5b						
Ref. No.	**733**	**740**	**754**	**755**	**764**	**765**	**770**
Ag	<1	<1	<1	<1	<1	<1	<1
Au							
As							
Ba	1100	960	300	430	660	140	1570
Be	10	4	7	8	6	5	7
Bi							
Co	15	5	<5	<5	5	20	6
Cr	35	<5	5	15	25	<5	<5
Cu	8	<5	10	15	15	<5	15
Ga	20	15	20	30	15	25	25
Hg							
Li	90	5	65	85	185	55	45
Mn							
Mo	<1	<1	<1	<1	<1	<1	<1
Nb	<30	<30	<30	<30	<30	<30	<30
Ni	15	<5	<5	7	9	<5	<5
Pb	195	45	55	150	45	35	70
Rb	260	240	420	290	310	220	250
Sb							
Sc	<5	<5	<5	5	<5	<5	<5
Sn	<3	<3	<3	<3	<3	<3	<3
Sr	1500	600	500	900	1000	350	1500
Ti							
V	100	20	25	35	50	<10	20
Y	25	<10	20	15	25	<10	<10
Zn	120	35	75	120	70	40	50
Zr	300	80	250	2000	300	70	200
La	250	100	100	<100	<100	<100	<100
Nd	<100	<100	<100	<100	<100	<100	<100
Ce	360	190	160	150	190	<50	150
Yb	<1	<1	<1	<1	<1	<1	<1

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Ref. No.	Sample No.	Ref. No.	Sample No.
733	WST14-1	764	WST25-27
740	WST18-8B	765	WST25-29
754	WST23-3	770	WST25-70
755	WST23-8		

TABLE A-3. CONTINUED.

	Unit 5c						
Ref. No.	699	701	700	702	703	704	705
Ag	<1	<1	<1	<1	<1	<1	<1
Au							
As							
Ba	780	1900	430	700	490	1300	1600
Be	7	7	4	5	5	7	5
Bi							
Co	9	<5	<5	<5	5	20	5
Cr	6	<5	<5	<5	<5	60	<5
Cu	15	8	20	15	10	8	20
Ga	15	15	20	20	20	20	20
Hg							
Li	30	6	6	9	6	70	7
Mn							
Mo	<1	<1	<1	<1	<1	<1	<1
Nb	<30	<30	<30	<30	<30	<30	<30
Ni	<5	<5	<5	<5	<5	45	<5
Pb	40	25	35	55	35	40	35
Rb	180	190	160	200	190	160	180
Sb							
Sc	<5	<5	<5	<5	<5	10	<5
Sn	<3	<3	<3	<3	<3	<3	<3
Sr	1000	1500	900	1000	1500	900	1500
Ti							
V	60	80	35	45	25	100	60
Y	45	60	35	30	15	25	60
Zn	40	45	25	30	50	115	40
Zr	150	250	90	300	150	250	200
La	300	<100	<100	<100	150	<100	<100
Nd	<100	<100	<100	<100	<100	<100	<100
Ce	410	130	160	160	280	330	150
Yb	2	3	<1	<1	<1	<1	4

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Ref. No.	Sample No.	Ref. No.	Sample No.
699	STR18-33A	703	STR18-36
701	STR18-34A	704	STR18-37B
700	STR18-33B	705	STR18-38
702	STR18-35		

TABLE A-3. CONTINUED.

	Unit 5c						
Ref. No.	706	707	708	709	710	711	712
Ag	<1	<1	<1	<1	<1	<1	<1
Au							
As							
Ba	1200	230	710	330	1200	460	580
Be	5	6	4	8	6	8	4
Bi							
Co	15	<5	6	6	15	7	<5
Cr	40	<5	<5	50	35	20	<5
Cu	10	<5	<5	15	20	6	6
Ga	15	20	20	15	15	20	15
Hg							
Li	50	20	15	40	55	20	4
Mn							
Mo	<1	<1	<1	<1	<1	<1	<1
Nb	<30	<30	<30	<30	<30	<30	<30
Ni	35	<5	<5	30	35	15	<5
Pb	25	20	20	30	40	30	35
Rb	200	240	160	170	140	190	130
Sb							
Sc	<5	<5	<5	<5	8	<5	<5
Sn	<3	<3	<3	<3	<3	<3	<3
Sr	1000	600	300	600	1000	600	700
Ti							
V	60	20	20	60	90	35	20
Y	30	<10	<10	20	30	<10	<10
Zn	110	45	75	115	100	90	30
Zr	150	100	800	300	300	200	80
La	<100	<100	<100	<100	200	100	<100
Nd	<100	<100	<100	<100	<100	<100	<100
Ce	220	<50	100	370	250	160	90
Yb	<1	<1	<1	<1	<1	<1	<1

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Ref. No.	Sample No.	Ref. No.	Sample No.
706	STR18-39	710	STR18-41B
707	STR18-40A	711	STR18-41C
708	STR18-40B	712	STR18-44
709	STR18-41A		

TABLE A-3. CONTINUED.

	Unit 5c						
Ref. No.	713	716	715	738	741	742	726
Ag	<1	<1	<1	<1	<1	<1	<1
Au							
As							
Ba	390	580	1300	520	1300	250	1100
Be	4	4	6	5	6	3	7
Bi							
Co	<5	<5	15	5	<5	6	10
Cr	<5	<5	45	<5	<5	<5	15
Cu	<5	<5	15	10	9	8	20
Ga	15	20	15	15	20	15	20
Hg							
Li	6	6	90	15	6	15	60
Mn							
Mo	<1	<1	<1	<1	<1	<1	<1
Nb	<30	<30	<30	<30	45	<30	<30
Ni	<5	<5	40	<5	<5	<5	10
Pb	30	20	120	70	60	45	55
Rb	120	140	140	190	150	230	210
Sb							
Sc	<5	<5	6	<5	<5	<5	<5
Sn	<3	<3	<3	<3	<3	<3	<3
Sr	600	400	1000	900	900	450	1500
Tl							
V	15	20	70	35	35	20	50
Y	<10	<10	25	<10	80	<10	20
Zn	35	35	85	50	55	35	75
Zr	150	250	200	50	800	150	250
La	<100	<100	<100	<100	100	<100	<100
Nd	<100	<100	<100	<100	<100	<100	<100
Ce	120	150	220	130	190	80	160
Yb	<1	<1	<1	<1	3	<1	<1

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Ref. No.	Sample No.	Ref. No.	Sample No.
713	STR18-45	741	WST18-10
716	STR18-46C	742	WST18-18
715	STR18-46B	726	STR19-12
738	WST18-7B		

TABLE A-3. CONTINUED.

	Unit 5d				Unit 5n		Unit 5j,p
Ref. No.	**737**	**739**	**744**	**761**	**757**	**762**	**725**
Ag	<1	<1	<1	<1	<1	<1	<1
Au							
As							
Ba	460	560	990	450	1140	840	840
Be	8	4	6	4	6	6	6
Bi							
Co	8	5	8	20	20	15	20
Cr	30	<5	15	<5	125	170	170
Cu	8	<5	7	8	35	35	15
Ga	20	15	20	15	15	15	15
Hg							
Li	25	5	20	10	45	35	20
Mn							
Mo	<1	<1	<1	<1	<1	<1	<1
Nb	<30	<30	<30	<30	<30	<30	<30
Ni	10	<5	8	<5	85	45	35
Pb	55	20	65	30	40	40	25
Rb	160	120	110	190	110	170	140
Sb							
Sc	<5	<5	<5	<5	15	15	15
Sn	<3	<3	<3	<3	<3	<3	<3
Sr	500	500	600	1000	1000	700	800
Ti							
V	45	15	40	45	100	150	100
Y	15	<10	20	20	20	30	20
Zn	60	40	120	50	110	95	90
Zr	600	100	500	150	300	600	200
La	<100	<100	150	<100	<100	<100	<100
Nd	<100	<100	<100	<100	<100	<100	<100
Ce	210	160	270	170	290	230	240
Yb	<1	<1	<1	<1	<1	<1	<1

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Ref. No.	Sample No.	Ref. No.	Sample No.
737	WST18-4A	757	WST25-7
739	WST18-8A	762	WST25-24
744	WST18-21	725	STR19-11
761	WST25-20		

TABLE A-3. CONTINUED.

	Unit 5j,p						
Ref. No.	667	731B	745	749	750	751	758
Ag	<1	<1	<1	<1	<1	<1	<1
Au							
As							
Ba	1100	1000	980	760	1100	1100	1150
Be	6	4	6	6	6	5	8
Bi							
Co	15	15	20	20	10	20	20
Cr	30	60	75	165	35	65	85
Cu	20	20	30	40	45	35	30
Ga	15	15	15	15	15	15	15
Hg							
Li	30	20	25	30	4	15	60
Mn							
Mo	<1	<1	<1	<1	<1	<1	<1
Nb	<30	<30	<30	<30	<30	<30	<30
Ni	10	45	30	45	25	35	45
Pb	25	35	80	30	40	30	55
Rb	130	80	100	140	60	80	170
Sb							
Sc	10	10	10	15	7	10	15
Sn	<3	<3	<3	<3	<3	<3	<3
Sr	1000	900	800	700	600	1000	1000
Ti							
V	100	100	100	100	150	100	100
Y	20	20	20	25	25	30	30
Zn	105	100	90	95	105	100	125
Zr	250	400	150	350	1000	500	300
La	<100	<100	<100	100	200	100	<100
Nd	<100	<100	<100	<100	<100	<100	<100
Ce	250	200	230	260	340	280	310
Yb	<1	<1	<1	1	1	<1	<1

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Ref. No.	Sample No.	Ref. No.	Sample No.
667	STR2-30	750	WST20-11
731B	STR26-4	751	WST20-13
745	WST18-25	758	WST25-8B
749	WST20-6		

TABLE A-3. CONTINUED.

	Unit 5j,p						
Ref. No.	756	759	760	768	769	766	731A
Ag	<1	<1	<1	<1	<1	<1	<1
Au							
As							
Ba	1210	920	1340	920	940	1570	1100
Be	4	6	4	5	6	5	4
Bi							
Co	20	20	<5	30	6	20	20
Cr	85	100	35	50	60	40	70
Cu	30	15	25	20	100	50	15
Ga	15	15	15	15	15	15	15
Hg							
Li	35	20	25	20	30	30	15
Mn							
Mo	<1	<1	<1	<1	<1	<1	<1
Nb	<30	<30	<30	<30	<30	<30	<30
Ni	45	60	15	35	40	25	45
Pb	30	20	25	40	35	30	35
Rb	100	110	90	80	110	110	50
Sb							
Sc	15	15	15	9	15	8	9
Sn	<3	<3	<3	<3	<3	<3	<3
Sr	1000	1000	900	1800	1000	1500	900
Ti							
V	150	100	100	80	200	90	100
Y	30	20	20	<10	35	30	15
Zn	110	115	100	95	120	105	90
Zr	300	200	300	300	300	200	150
La	<100	<100	<100	<100	150	150	<100
Nd	<100	<100	<100	<100	<100	<100	<100
Ce	310	290	280	250	370	340	190
Yb	<1	<1	<1	<1	<1	<1	<1

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Ref. No.	Sample No.	Ref. No.	Sample No.
756	WST25-4C	769	WST25-60
759	WST25-14	766	WST25-44
760	WST25-19	731A	STR26-1
768	WST25-53		

TABLE A-3. CONTINUED.

	Unit 6b						
Ref. No.	378	379	375	376	377	380	370
Ag	<1	<1	<1	<1	<1	<1	<1
Au							
As							
Ba	880	1780	920	980	920	100	450
Be	<1	<1	3	3	2	4	3
Bi							
Co	7	8	7	6	5	7	6
Cr	5	<5	<5	<5	<5	<5	<5
Cu	5	5	7	8	8	<5	<5
Ga	15	15	15	20	20	10	20
Hg							
Li	30	25	30	15	25	40	10
Mn							
Mo	<1	<1	<1	<1	<1	<1	<1
Nb	<30	<30	<30	<30	<30	<30	<30
Ni	<5	<5	<5	<5	<5	<5	<5
Pb	15	15	25	15	15	30	<10
Rb	180	220	230	190	190	290	180
Sb							
Sc	<5	<5	<5	<5	<5	<5	<5
Sn	<3	<3	<3	<3	<3	<3	<3
Sr	1000	900	900	900	1500	450	800
Ti							
V	40	60	20	25	30	30	20
Y	15	<10	<10	<10	<10	<10	<10
Zn	60	80	70	45	50	100	40
Zr	200	25	30	400	200	100	200
La	<100	<100	<100	<100	<100	<100	<100
Nd	<100	<100	<100	<100	<100	<100	<100
Ce	210	190	120	150	120	50	80
Yb	<1	<1	<1	<1	<1	<1	<1

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Ref. No.	Sample No.	Ref. No.	Sample No.
378	SQW-4	377	SWQ-3B
379	SQW-7	380	SQW-9
375	SQW-2	370	WSQ6-2
376	SQW-3A		

TABLE A-3. CONTINUED.

	Unit 6b				Unit 6d	Unit 6g	
Ref. No.	**371**	**372**	**373**	**374**	**383**	**384**	**385**
Ag	<1	<1	<1	<1	<1	>1	<1
Au							
As							
Ba	370	590	1640	1100	690	250	280
Be	<1	<1	<1	<1	9	5	4
Bi							
Co	5	5	7	6	10	15	7
Cr	<5	<5	<5	<5	20	30	<5
Cu	<5	<5	<5	5	6	<5	<5
Ga	15	20	15	15	20	20	20
Hg							
Li	10	10	20	15	10	25	8
Mn							
Mo	<1	<1	<1	<1	<1	<1	<1
Nb	<30	<30	<30	<30	<30	<30	<30
Ni	<5	<5	<5	<5	10	25	<5
Pb	<10	10	10	15	40	25	10
Rb	150	130	210	130	80	40	160
Sb							
Sc	<5	<5	<5	<5	5	7	<5
Sn	<3	<3	<3	<3	<3	<3	<3
Sr	800	1000	800	800	600	700	200
Ti							
V	40	20	20	30	50	60	15
Y	<10	<10	<10	10	30	20	10
Zn	50	30	50	40	100	100	50
Zr	25	10	100	90	1000	350	90
La	<100	<100	<100	<100	150	100	100
Nd	<100	<100	<100	<100	<100	<100	<100
Ce	<50	90	90	160	240	220	160
Yb	<1	<1	<1	<1	1	<1	<1

Notes: For sample descriptions, see Table A-1. Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Ref. No.	Sample No.	Ref. No.	Sample No.
371	WSQ6-4	383	SQW-12
372	WSQ6-5	384	SQW-21
373	WSQ6-6	385	SQW-22
374	WSQ6-8		

TABLE A-4. NORMATIVE MINERALS (CIPW NORM) FOR WHOLE-ROCK SAMPLES FROM THE STURGEON NARROWS AND SQUAW LAKE ALKALIC ROCK COMPLEXES.

	Unit 5a						
Ref. No.	677	678	680	681	682	679	683
S.G.	2.65	2.59	2.60	2.66	2.66	2.64	2.68
AP	0.873	0.575	0.120	0.498	0.425	0.679	0.309
PO	0.112	0.028	0.399	0.309	0.307	0.115	0.140
IL	2.357	0.923	0.513	0.758	0.658	0.913	0.584
OR	30.801	36.619	44.532	45.018	47.657	44.952	43.447
AB	40.788	27.396	8.667	17.891	14.345	13.984	10.299
AN	8.204	2.025	0.0	0.0	0.0	0.505	0.0
C	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AC	0.0	0.0	6.189	0.924	3.614		8.498
MT	4.158	3.522	0.0	2.783	1.211		0.242
HM	0.0	0.0	0.0	0.687	0.493	0.0	0.0
WO	0.0	0.031	0.369	2.411	2.852	0.0	1.960
EN	0.085	0.0	0.0	0.0	0.0	0.0	0.0
FS	0.329	0.0	0.0	0.0	0.0	0.0	0.0
Q	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DI	1.762	8.550	3.403	7.803	5.471	7.467	3.852
FO	0.876	0.0	0.0	0.0	0.0	1.077	0.0
FA	3.727	0.0	0.0	0.0	0.0	0.888	0.0
NE	0.0	19.408	31.025	20.919	22.966	22.561	29.622
LC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KP	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE	5.928	0.924	3.097	0.0	0.0	4.873	1.047
CC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RU	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NS	0.0	0.0	1.687	0.0	0.0	0.0	0.0
KS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CR	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LN	0.0	0.0	0.0	0.0	0.0	0.0	0.0

S.G. - Specific Gravity; AP - Apatite; PO - Pyrrhotite; IL - Ilmenite;
OR - Orthoclase; AB - Albite; AN - Anorthite; C - Corundum;
AC - Acmite; MT - Magnetite; HM - Hematite; WO - Wollastonite;
EN - Enstatite; FS - Ferrosilite; Q - Quartz; DI - Diopside;
FO - Forsterite; FA - Fayalite; NE - Nepheline; LC - Leucite;
KP - Kaliophilite; HE - Hedenbergite; CC - Calcite; RU - Rutile;
NS - Na_2SiO_3; KS - Kalsilite; CR - Chromite; LN - Larnite.

Note: For sample descriptions, see Table A-1.

Ref. No.	Sample No.	Ref. No.	Sample No.
677	STR4-20	682	STR11-9
678	STR4-23	679	STR11-7A
680	STR11-8A	683	STR11-11
681	STR11-8B		

TABLE A-4. CONTINUED.

	Unit 5a						
Ref. No.	**684**	**685**	**686**	**690**	**689**	**692**	**694**
S.G.	2.65	2.59	2.57	2.67	2.58	2.57	2.67
AP	0.380	0.289	0.292	0.358	0.121	0.242	0.619
PO	0.309	0.427	0.862	0.733	2.182	0.657	0.394
IL	0.545	0.668	-0.645	1.112	-2.726	0.850	1.131
OR	49.229	50.580	44.061	36.658	42.494	39.970	36.422
AB	5.800	7.110	13.436	0.0	15.620	12.786	22.776
AN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AC	4.696	5.170	6.244	7.432	5.939	4.097	3.905
MT	0.768	0.0	0.0	0.0	0.0	0.0	1.476
HM	0.338	0.0	0.0	0.0	0.0	0.0	1.368
WO	2.414	2.378	1.742	5.606	1.941	0.786	3.005
EN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Q	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DI	4.955	3.237	1.857	2.815	0.563	2.964	8.930
FO	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FA	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NE	30.565	28.236	29.203	41.999	28.796	33.310	19.974
LC	0.0	0.0	0.0	2.186	0.0	0.0	0.0
KP	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE	0.0	0.0	0.0	0.269	0.0	1.182	0.0
CC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RU	0.0	0.074	0.591	0.0	1.613	0.0	0.0
NS	0.0	1.829	2.357	0.833	3.457	3.158	0.0
KS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CR	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LN	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note: For sample descriptions, see Table A-1.

Ref. No.	Sample No.	Ref. No.	Sample No.
684	STR11-15B	689	STR16-6B
685	STR11-16C	692	STR16-18
686	STR11-19A	694	STR17-3
690	STR16-8		

TABLE A-4. CONTINUED.

	Unit 5a						
Ref. No.	695	696	697	698	717	718	719
S.G.	2.68	2.68	2.64	2.65	2.69	2.71	2.63
AP	0.595	0.576	0.338	0.380	0.739	0.718	0.284
PO	0.281	0.539	0.114	0.169	0.366	0.481	0.028
IL	1.013	0.903	0.652	0.195	1.113	1.176	0.522
OR	37.803	35.599	42.197	51.838	42.977	35.173	42.480
AB	26.302	27.350	29.815	26.318	20.421	26.093	43.477
AN	1.808	0.0	11.187	0.837	2.101	3.162	2.397
C	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AC	0.0	2.521	0.0	0.0	0.0	0.0	0.0
MT	3.897	2.239	2.412	1.509	3.902	3.130	1.964
HM	0.0	0.004	0.0	1.183	0.629	0.701	0.0
WO	0.888	1.016	0.0	1.939	1.316	0.0	0.0
EN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Q	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DI	9.919	9.221	0.545	5.506	10.323	11.749	2.173
FO	0.0	0.0	1.366	0.0	0.0	0.002	0.076
FA	0.0	0.0	0.163	0.0	0.0	0.0	0.063
NE	17.207	20.032	11.160	10.125	16.115	17.614	5.113
LC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KP	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE	0.287	0.0	0.051	0.0	0.0	0.0	1.420
CC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RU	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CR	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LN	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note: For sample descriptions, see Table A-1.

Ref. No.	Sample No.	Ref. No.	Sample No.
695	STR17-5	717	STR18-48
696	STR17-7	718	STR18-52
697	STR17-8	719	STR18-58
698	STR17-9		

TABLE A-4. CONTINUED.

	Unit 5a						
Ref. No.	**720**	**721**	**722**	**723**	**724**	**727**	**728**
S.G.	2.64	2.66	2.70	2.64	2.73	2.68	2.70
AP	0.259	0.425	0.403	0.375	0.835	0.594	0.667
PO	0.028	0.028	0.140	1.192	0.056	0.393	0.141
IL	0.539	0.657	0.835	0.763	1.192	0.953	1.073
OR	41.854	39.163	37.689	39.45	39.741	34.299	33.892
AB	45.183	29.441	40.898	28.99	27.515	29.717	32.184
AN	2.724	9.760	10.634	8.712	8.556	2.045	6.814
C	0.0	0.0	0.897	0.0	0.0	0.0	0.0
AC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MT	2.704	1.910	2.447	0.0	3.909	2.763	3.556
HM	0.0	1.072	0.0	1.546	0.0	0.471	0.638
WO	0.0	0.0	0.0	0.0	0.0	0.182	0.0
EN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Q	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DI	2.477	3.174	0.0	3.089	5.068	9.465	10.441
FO	0.151	1.045	1.892	1.007	2.681	0.0	0.496
FA	0.052	0.0	0.493	0.0	0.994	0.0	0.0
NE	3.355	13.325	3.675	14.678	7.966	19.118	10.098
LC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KP	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE	0.675	0.0	0.0	0.0	1.487	0.0	0.0
CC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RU	0.0	0.0	0.0	0.185	0.0	0.0	0.0
NS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CR	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LN	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note: For sample descriptions, see Table A-1.

Ref. No.	Sample No.	Ref. No.	Sample No.
720	STR18-59	724	STR19-9
721	STR19-1	727	STR19-14A
722	STR19-2	728	STR19-15
723	STR19-5		

TABLE A-4. CONTINUED.

	Unit 5a						
Ref. No.	729	734	735	732	736	743	746
S.G.	2.69	2.64	2.60	2.93	2.67	2.72	2.70
AP	0.639	0.328	0.217	1.108	1.240	0.858	0.903
PO	0.559	0.221	0.713	1.794	0.891	0.619	0.112
IL	1.046	0.671	0.790	0.331	0.358	1.346	1.167
OR	36.437	43.457	40.473	23.410	30.305	32.800	37.850
AB	27.888	43.318	21.236	4.103	5.600	22.139	33.190
AN	0.445	4.628	0.0	0.0	0.0	1.370	12.618
C	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AC	0.0	0.0	4.603	9.493	8.912	0.0	0.0
MT	1.965	1.583	0.0	0.0	0.0	0.887	2.242
HM	1.582	0.593	0.0	6.203	0.0	3.116	0.0
WO	0.967	0.0	0.495	19.721	8.233	3.403	0.0
EN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Q	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DI	10.628	3.355	2.178	8.537	4.840	11.804	1.598
FO	0.0	0.196	0.0	0.0	0.0	0.0	2.894
FA	0.0	0.0	0.0	0.0	0.0	0.0	1.973
NE	17.850	1.650	27.239	23.458	35.801	21.660	4.592
LC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KP	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE	0.0	0.0	1.836	0.0	1.611	0.0	0.862
CC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RU	0.0	0.0	0.0	1.841	0.0	0.0	0.0
NS	0.0	0.0	0.219	0.0	2.210	0.0	0.0
KS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CR	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LN	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note: For sample descriptions, see Table A-1.

Ref. No.	Sample No.	Ref. No.	Sample No.
729	STR19-16	736	WST18-3
734	WST14-6	743	WST18-20
735	WST14-17	746	WST20-2
732	WST13-1		

TABLE A-4. CONTINUED.

	Unit 5a						
Ref. No.	**747**	**748**	**752**	**763**	**767**	**665**	**666**
S.G.	2.84	2.79	2.65	2.81	2.69	2.69	2.58
AP	1.371	0.964	0.421	1.116	0.611	0.242	0.363
PO	0.084	0.028	0.193	0.253	0.028	0.057	0.229
IL	1.665	1.386	0.670	1.807	0.693	0.774	0.911
OR	35.150	28.416	31.456	36.739	31.240	50.435	44.205
AB	18.513	35.96	53.578	17.187	50.715	29.861	22.866
AN	7.759	8.663	5.064	3.851	4.451	8.492	2.599
C	0.0	0.0	0.0	0.0	0.0	3.591	0.0
AC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MT	7.744	2.807	2.432	5.489	2.107	0.826	2.513
HM	0.0	0.0	0.186	0.0	1.487	1.332	0.310
WO	0.009	0.0	0.0	1.526	0.0	0.0	0.493
EN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Q	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DI	21.025	8.135	3.108	12.477	5.606	0.0	5.319
FO	0.0	4.361	0.941	0.0	1.310	0.930	0.0
FA	0.0	2.911	0.0	0.0	0.0	0.0	0.0
NE	5.575	2.073	1.952	17.047	1.752	3.460	20.194
LC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KP	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE	1.107	4.296	0.0	2.507	0.0	0.0	0.0
CC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RU	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CR	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LN	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note: For sample descriptions, see Table A-1.

Ref. No.	Sample No.	Ref. No.	Sample No.
747	WST20-3	767	WST25-52
748	WST20-5	665	STR2-15
752	WST20-14	666	STR2-18
763	WST25-25		

TABLE A-4. CONTINUED.

	Unit 5a						
Ref. No.	668	669	670	671	672	673	676
S.G.	2.57	2.60	2.65	2.58	2.63	2.58	2.80
AP	0.433	0.438	0.627	0.291	0.243	0.193	1.269
PO	0.285	0.431	0.627	0.946	0.172	0.342	0.396
IL	0.946	0.757	0.968	0.675	0.537	0.769	1.176
OR	37.935	43.975	36.599	40.763	48.889	39.479	28.943
AB	24.221	22.252	27.688	14.909	23.143	14.674	20.627
AN	1.491	5.400	1.064	0.0	9.644	0.0	4.138
C	0.0	0.0	0.0	0.0	0.694	0.0	0.0
AC	0.0	0.0	0.0	3.540	0.0	3.724	0.0
MT	2.560	1.490	2.051	0.0	1.805	0.0	5.283
HM	0.538	0.0	0.0	0.0	0.0	0.0	0.0
WO	0.884	0.0	0.0	1.567	0.0	1.676	0.0
EN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Q	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DI	6.299	3.717	7.704	3.483	0.0	1.617	17.607
FO	0.0	0.750	0.727	0.0	0.876	0.0	0.351
FA	0.0	0.600	0.331	0.0	0.591	0.0	0.036
NE	24.407	17.839	18.842	30.85	13.405	36.111	18.728
LC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KP	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE	0.0	2.351	2.772	1.646	0.0	0.972	1.445
CC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RU	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NS	0.0	0.0	0.0	1.325	0.0	0.444	0.0
KS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CR	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LN	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note: For sample descriptions, see Table A-1.

Ref. No.	Sample No.	Ref. No.	Sample No.
668	STR2-31	672	STR4-3
669	STR2-35	673	STR4-10
670	STR2-39	676	STR4-13C
671	STR4-1		

TABLE A-4. CONTINUED.

	Unit 5a	Unit 5b					
Ref. No.	730	687	688	691	693	674	675
S.G.	2.69	2.57	2.61	2.58	2.58	2.79	2.59
AP	0.668	0.120	0.631	0.219	0.192	1.207	0.266
PO	0.113	1.139	1.663	0.316	0.737	0.308	1.172
IL	0.821	-0.956	-1.585	0.717	0.454	1.124	0.792
OR	37.676	38.210	43.779	43.808	39.516	30.780	36.747
AB	22.859	22.169	19.097	12.786	9.023	21.962	20.288
AN	5.930	0.0	0.0	0.0	0.0	3.656	0.0
C	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AC	0.0	4.327	6.261	4.097	2.423	0.0	4.644
MT	1.871	0.0	0.0	0.0	0.0	4.808	0.0
HM	2.136	0.0	0.0	0.0	0.0	0.0	0.0
WO	2.216	2.546	2.573	0.153	2.247	0.0	1.303
EN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Q	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DI	8.899	0.725	0.842	2.085	1.500	15.592	3.639
FO	0.0	0.0	0.0	0.0	0.0	0.597	0.0
FA	0.0	0.0	0.0	0.0	0.0	0.098	0.0
NE	16.810	26.945	23.238	30.639	41.797	17.846	28.926
LC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KP	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE	0.0	0.0	0.0	3.046	0.0	2.022	0.586
CC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RU	0.0	0.773	1.191	0.0	0.206	0.0	0.0
NS	0.0	4.001	2.771	2.134	1.905	0.0	1.636
KS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CR	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LN	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note: For sample descriptions, see Table A-1.

Ref. No.	Sample No.	Ref. No.	Sample No.
730	STR19-18	693	STR17-2A
687	STR16-2	674	STR4-12
688	STR16-3	675	STR4-13B
691	STR16-13		

TABLE A-4. CONTINUED.

	Unit 5b						
Ref. No.	733	740	754	755	764	765	770
S.G.	2.74	2.62	2.62	2.60	2.62	2.61	2.58
AP	0.596	0.095	0.188	0.218	0.334	0.071	0.241
PO	0.761	0.028	0.167	0.600	0.085	0.028	0.797
IL	0.645	0.427	0.770	0.614	0.743	0.077	-0.366
OR	35.271	43.896	45.546	40.126	44.949	32.525	45.009
AB	23.048	44.350	20.983	19.094	29.846	29.959	9.781
AN	0.0	0.0	0.0	0.0	13.360	0.0	0.0
C	0.0	0.0	0.0	0.0	0.122	0.0	0.0
AC	6.660	2.833	0.473	5.397	0.0	0.529	3.124
MT	0.0	0.179	0.740	0.0	2.523	0.045	0.0
HM	1.944	0.0	0.917	0.0	0.0	0.0	0.0
WO	5.609	1.409	1.108	2.157	0.0	0.683	3.611
EN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Q	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DI	8.284	0.822	2.177	2.911	0.0	0.656	1.840
FO	0.0	0.0	0.0	0.0	1.905	0.0	0.0
FA	0.0	0.0	0.0	0.0	0.120	0.0	0.0
NE	16.781	5.907	26.932	26.959	6.013	33.851	33.921
LC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KP	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE	0.0	0.056	0.0	0.870	0.0	1.576	0.0
CC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RU	0.401	0.0	0.0	0.0	0.0	0.0	0.421
NS	0.0	0.0	0.0	1.056	0.0	0.0	1.621
KS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CR	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LN	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note: For sample descriptions, see Table A-1.

Ref. No.	Sample No.	Ref. No.	Sample No.
733	WST14-1	764	WST25-27
740	WST18-8B	765	WST25-29
754	WST23-3	770	WST25-70
755	WST23-8		

TABLE A-4. CONTINUED.

	Unit 5c						
Ref. No.	**699**	**701**	**700**	**702**	**703**	**704**	**705**
S.G.	2.68	2.62	2.56	2.59	2.61	2.80	2.64
AP	0.450	0.192	0.143	0.143	0.166	1.370	0.167
PO	0.701	1.076	1.922	1.241	0.224	0.028	1.070
IL	0.650	-1.135	-2.685	-1.120	0.456	1.837	-0.978
OR	37.900	41.338	34.988	43.020	39.518	27.219	38.757
AB	34.625	26.561	27.007	25.800	42.077	33.060	27.653
AN	0.0	0.0	0.0	0.0	0.0	2.358	0.0
C	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AC	5.210	6.989	4.532	4.970	0.666	0.0	7.636
MT	0.0	0.0	0.0	0.0	0.0	5.625	0.0
HM	2.093	0.0	0.0	0.0	1.272	0.264	0.0
WO	3.937	4.448	2.852	3.993	3.626	0.0	5.011
EN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Q	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DI	3.788	1.054	0.775	0.663	1.043	17.134	1.158
FO	0.0	0.0	0.0	0.0	0.0	1.345	0.0
FA	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NE	10.592	18.303	26.091	19.676	10.836	9.761	18.180
LC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KP	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RU	0.056	0.845	1.558	0.775	0.117	0.0	0.843
NS	0.0	0.330	2.816	0.839	0.0	0.0	0.501
KS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CR	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LN	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note: For sample descriptions, see Table A-1.

Ref. No.	Sample No.	Ref. No.	Sample No.
699	STR18-33A	703	STR18-36
701	STR18-34A	704	STR18-37B
700	STR18-33B	705	STR18-38
702	STR18-35		

TABLE A-4. CONTINUED.

	Unit 5c						
Ref. No.	706	707	708	709	710	711	712
S.G.	2.72	2.63	2.64	2.75	2.76	2.65	2.62
AP	1.100	0.118	0.163	0.548	1.247	0.259	0.118
PO	1.130	0.056	0.028	0.423	0.334	0.446	0.250
IL	0.750	0.232	0.172	0.761	1.310	0.328	0.347
OR	39.068	42.993	37.655	33.055	28.555	38.660	30.098
AB	22.193	25.045	52.880	31.392	35.763	36.618	54.879
AN	0.0	0.0	0.0	0.0	2.933	0.0	0.0
C	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AC	8.198	4.265	3.144	7.708	0.0	4.153	2.903
MT	0.0	0.0	0.705	1.376	1.539	0.294	0.0
HM	0.0	0.0	0.147	0.824	2.975	0.903	0.0
WO	0.383	0.614	1.382	4.828	0.207	1.960	1.710
EN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Q	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DI	12.509	0.874	2.269	7.449	16.016	3.549	1.035
FO	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FA	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NE	13.689	24.824	1.456	11.636	9.121	12.830	8.575
LC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KP	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE	0.0	0.765	0.0	0.0	0.0	0.0	0.024
CC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RU	0.254	0.0	0.0	0.0	0.0	0.0	0.0
NS	0.727	0.215	0.0	0.0	0.0	0.0	0.062
KS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CR	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LN	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note: For sample descriptions, see Table A-1.

Ref. No.	Sample No.	Ref. No.	Sample No.
706	STR18-39	710	STR18-41B
707	STR18-40A	711	STR18-41C
708	STR18-40B	712	STR18-44
709	STR18-41A		

TABLE A-4. CONTINUED.

	Unit 5c						
Ref. No.	713	716	715	738	741	742	726
S.G.	2.61	2.62	2.74	2.58	2.59	2.60	2.66
AP	0.142	0.142	0.804	0.120	0.192	0.165	0.425
PO	0.056	0.056	0.140	0.199	1.305	0.028	0.028
IL	0.310	0.425	1.181	0.374	-1.354	0.329	0.735
OR	34.472	36.484	26.529	40.061	42.102	51.707	41.516
AB	54.799	55.085	45.994	29.011	21.103	41.574	37.792
AN	0.0	0.0	2.629	0.0	0.0	3.695	6.920
C	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AC	1.124	1.797	0.0	4.261	5.118	0.0	0.0
MT	0.597	0.453	2.465	0.0	0.0	1.564	2.939
HM	0.290	0.217	1.419	0.0	0.0	0.0	0.0
WO	1.242	1.203	0.0	1.619	3.501	0.0	0.0
EN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Q	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DI	0.876	0.984	12.288	0.446	0.722	0.379	2.720
FO	0.0	0.0	0.259	0.0	0.0	0.410	0.858
FA	0.0	0.0	0.0	0.0	0.0	0.054	0.165
NE	6.094	3.156	6.292	21.928	24.447	0.054	5.487
LC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KP	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE	0.0	0.0	0.0	1.694	0.0	0.039	0.413
CC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RU	0.0	0.0	0.0	0.0	0.951	0.0	0.0
NS	0.0	0.0	0.0	0.286	1.914	0.0	0.0
KS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CR	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LN	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note: For sample descriptions, see Table A-1.

Ref. No.	Sample No.	Ref. No.	Sample No.
713	STR18-45	741	WST18-10
716	STR18-46C	742	WST18-18
715	STR18-46B	726	STR19-12
738	WST18-7B		

TABLE A-4. CONTINUED.

	Unit 5d				Unit 5n		Unit 5j,p
Ref. No.	737	739	744	761	757	762	725
S.G.	2.65	2.64	2.69	2.64	2.79	2.79	2.78
AP	0.352	0.163	0.494	0.141	1.080	0.911	0.898
PO	0.250	0.028	0.056	0.139	0.028	0.028	0.028
IL	0.576	0.457	0.924	0.617	1.422	1.282	1.258
OR	34.050	34.772	31.911	44.467	21.671	29.555	29.413
AB	48.273	55.681	53.726	18.203	41.022	35.085	37.603
AN	0.0	0.0	1.647	1.070	8.700	9.152	9.488
C	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AC	3.076	2.580	0.0	0.0	0.0	0.0	0.0
MT	0.552	0.525	0.832	2.121	3.199	2.877	4.004
HM	0.569	0.0	2.337	0.0	0.0	0.0	0.0
WO	0.999	1.187	1.597	1.561	0.0	0.0	0.0
EN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Q	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DI	5.217	1.401	5.229	1.310	9.453	7.410	7.626
FO	0.0	0.0	0.0	0.0	4.718	4.273	4.262
FA	0.0	0.0	0.0	0.0	1.898	2.760	1.860
NE	6.086	2.963	1.247	30.043	3.801	2.879	0.927
LC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KP	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE	0.0	0.243	0.0	0.327	3.008	3.787	2.633
CC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RU	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CR	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LN	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note: For sample descriptions, see Table A-1.

Ref. No.	Sample No.	Ref. No.	Sample No.
737	WST18-4A	757	WST25-7
739	WST18-8A	762	WST25-24
744	WST18-21	725	STR19-11
761	WST25-20		

TABLE A-4. CONTINUED.

	Unit 5j,p						
Ref. No.	**667**	**731B**	**745**	**749**	**750**	**751**	**758**
S.G.	2.76	2.76	2.77	2.79	2.68	2.57	2.78
AP	0.848	0.752	0.900	0.916	0.494	1.154	1.180
PO	0.028	0.028	0.028	0.028	0.056	0.028	0.028
IL	1.176	1.232	1.202	1.269	0.925	1.272	1.333
OR	25.643	18.279	27.828	29.531	25.991	24.737	25.572
AB	43.724	47.320	40.013	35.354	53.835	39.019	36.715
AN	9.239	13.315	6.229	7.870	8.295	9.928	6.899
C	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MT	5.535	3.687	4.468	3.083	3.693	5.004	5.501
HM	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WO	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EN	0.0	5.002	0.0	0.0	0.232	0.0	0.0
FS	0.0	1.661	0.0	0.0	0.029	0.0	0.0
Q	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DI	7.191	6.182	9.895	8.079	3.674	9.812	11.341
FO	2.129	0.551	2.804	4.126	2.097	3.083	3.079
FA	0.246	0.202	0.966	2.467	0.285	0.747	0.473
NE	3.582	0.0	2.972	3.452	0.0	3.334	6.499
LC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KP	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE	0.659	1.789	2.697	3.822	0.394	1.882	1.379
CC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RU	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CR	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LN	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note: For sample descriptions, see Table A-1.

Ref. No.	Sample No.	Ref. No.	Sample No.
667	STR2-30	750	WST20-11
731B	STR26-4	751	WST20-13
745	WST18-25	758	WST25-8B
749	WST20-6		

TABLE A-4. CONTINUED.

	Unit 5J,p						
Ref. No.	756	759	760	768	769	766	731A
S.G.	2.82	2.80	2.79	2.73	2.89	2.72	2.76
AP	1.321	1.160	0.940	0.728	1.663	1.244	0.782
PO	0.028	0.028	0.111	0.056	0.498	0.028	0.028
IL	1.487	1.579	1.290	1.019	1.726	1.461	0.990
OR	26.158	16.736	24.158	19.042	30.697	23.642	19.105
AB	32.609	45.198	44.004	46.766	14.146	47.222	48.774
AN	9.971	12.397	11.705	12.911	4.981	7.748	13.107
C	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MT	4.378	5.117	4.114	3.625	5.929	4.005	3.379
HM	0.0	0.0	2.726	0.0	0.0	0.0	0.0
WO	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EN	0.0	0.0	0.0	5.618	0.0	0.0	0.225
FS	0.0	0.0	0.0	1.646	0.0	0.0	0.086
Q	0.0	0.0	0.0	4.414	0.0	0.0	0.0
DI	10.253	9.067	6.436	3.325	17.439	6.546	5.895
FO	4.014	5.195	3.781	0.0	1.384	2.800	3.974
FA	1.497	1.107	0.0	0.0	0.528	0.732	1.681
NE	5.260	0.941	0.735	0.0	15.753	3.220	0.0
LC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KP	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE	3.026	1.529	0.0	0.850	5.261	1.353	1.973
CC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RU	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CR	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LN	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note: For sample descriptions, see Table A-1.

Ref. No.	Sample No.	Ref. No.	Sample No.
756	WST25-4C	769	WST25-60
759	WST25-14	766	WST25-44
760	WST25-19	731A	STR26-1
768	WST25-53		

TABLE A-4. CONTINUED.

	Unit 6b						
Ref. No.	**378**	**379**	**375**	**376**	**377**	**380**	**370**
S.G.	2.60	2.61	2.59	2.58	2.60	2.60	2.58
AP	0.537	0.849	0.144	0.218	0.191	0.072	0.142
PO	0.173	0.516	0.085	0.917	0.085	0.254	0.616
IL	1.079	0.993	0.848	0.714	0.999	0.664	0.698
OR	49.914	48.575	39.726	39.743	41.677	43.376	50.348
AB	23.758	13.344	42.594	30.838	44.223	31.455	32.204
AN	2.714	0.417	4.975	0.0	4.117	0.0	0.0
C	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AC	0.0	0.0	0.0	3.053	0.0	1.780	1.376
MT	1.480	3.944	1.461	0.0	1.977	1.942	0.598
HM	0.0	0.0	0.508	0.0	0.091	0.0	0.0
WO	3.581	2.113	2.037	4.246	0.444	0.445	0.0
EN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Q	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DI	4.748	4.552	1.673	1.403	2.161	1.326	1.563
FO	0.0	0.0	0.0	0.0	0.0	0.0	0.098
FA	0.0	0.0	0.0	0.0	0.0	0.0	0.066
NE	9.603	22.355	5.948	17.749	4.035	16.421	11.460
LC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KP	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE	2.414	2.343	0.0	0.287	0.0	2.265	0.833
CC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RU	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NS	0.0	0.0	0.0	0.830	0.0	0.0	0.0
KS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CR	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LN	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note: For sample descriptions, see Table A-1.

Ref. No.	Sample No.	Ref. No.	Sample No.
378	SQW-4	377	SWQ-3B
379	SQW-7	380	SQW-9
375	SQW-2	370	WSQ6-2
376	SQW-3A		

TABLE A-4. CONTINUED.

	Unit 6b				Unit 6d	Unit 6g	
Ref. No.	371	372	373	374	383	384	385
S.G.	2.63	2.55	2.59	2.57	2.68	2.73	2.58
AP	0.189	0.195	0.216	0.491	0.566	0.825	0.418
PO	0.112	1.414	0.794	1.740	0.056	0.084	0.082
IL	0.775	-0.661	0.550	-1.014	1.023	1.255	0.590
OR	40.689	44.579	56.569	40.597	23.270	15.149	36.037
AB	48.318	15.047	15.419	4.882	59.152	55.517	54.186
AN	0.788	0.0	0.0	0.0	6.077	10.378	0.0
C	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AC	0.0	2.010	3.799	5.905	0.0	0.0	1.111
MT	2.960	0.0	0.0	0.0	3.361	3.551	0.952
HM	0.0	0.0	0.0	0.0	0.0	0.0	0.282
WO	0.348	6.248	0.0	3.188	0.0	0.0	1.180
EN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Q	0.0	0.0	0.0	0.0	0.0	0.0	2.901
DI	1.919	0.565	2.110	2.045	5.048	7.013	2.261
FO	0.0	0.0	0.397	0.0	0.595	1.127	0.0
FA	0.0	0.0	0.275	0.0	0.109	0.332	0.0
NE	2.874	27.463	18.376	38.518	0.012	3.138	0.0
LC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
KP	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HE	1.028	0.0	1.156	0.0	0.731	1.633	0.0
CC	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RU	0.0	0.485	0.0	0.819	0.0	0.0	0.0
NS	0.0	2.656	0.339	2.828	0.0	0.0	0.0
KS	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CR	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LN	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note: For sample descriptions, see Table A-1.

Ref. No.	Sample No.	Ref. No.	Sample No.
371	WSQ6-4	383	SQW-12
372	WSQ6-5	384	SQW-21
373	WSQ6-6	385	SQW-22
374	WSQ6-8		

TABLE A-5. AVERAGE CHEMICAL COMPOSITIONS (WEIGHT PERCENT AND PPM) OF LITHOLOGIC UNITS FOR THE STURGEON NARROWS AND SQUAW LAKE ALKALIC ROCK COMPLEXES.

	Unit 5a (N = 50)		Unit 5b (N = 13)	
	Mean	Std. Deviation	Mean	Std. Deviation
SiO_2	55.15	3.00	55.32	2.73
Al_2O_3	19.03	1.79	20.22	2.06
Fe_2O_3	2.43	1.28	1.69	1.02
FeO	1.59	1.11	0.89	0.66
MgO	1.34	0.86	0.68	0.85
CaO	3.31	1.90	2.22	1.53
Na_2O	6.92	1.71	8.66	1.93
K_2O	6.45	1.00	6.55	0.81
TiO_2	0.50	0.29	0.34	0.18
P_2O_5	0.23	0.13	0.14	0.13
MnO	0.10	0.04	0.07	0.04
CO_2	0.66	0.50	0.72	0.54
S	0.14	0.15	0.21	0.18
H_2O+	0.88	0.51	0.94	0.45
H_2O-	0.36	0.06	0.34	0.09
L.O.I.	0.00	0.00	0.00	0.00
TOTAL	99.11	0.65	98.96	0.69
Ag	<1.00	0.00	<1.00	0.00
Ba	925.40	586.20	745.38	443.31
Co	9.34	4.45	6.85	7.72
Cr	30.72	28.52	10.08	19.98
Cu	16.06	12.53	11.15	11.16
Li	52.64	33.17	59.31	48.25
Ni	10.64	13.00	2.54	12.06
Pb	49.70	36.27	62.31	51.58
Zn	86.80	29.96	75.38	34.37
Be	6.80	2.12	6.69	1.97
Mo	<0.94	0.42	<1.00	0.00
Sc	<1.66	5.94	<1.62	7.08
Sr	995.00	377.46	846.15	355.59
V	67.60	81.18	36.15	31.63
Y	21.30	24.13	5.77	18.13
Ga	17.20	2.89	21.15	4.63
Nb	<28.70	9.19	<30.00	0.00
Rb	200.40	67.46	255.38	79.44
Zr	310.00	159.40	396.15	510.81
Sn	<2.20	2.78	<3.00	0.00
Eu	<100.00	0.00	<100.00	0.00
Yb	<0.50	1.74	<1.00	0.00
La	<20.00	122.89	<7.69	127.22
Nd	<84.00	79.18	<100.00	0.00
Ce	255.00	131.59	183.85	113.40

TABLE A-5. CONTINUED.

	Unit 5c (N = 21)		Unit 5d (N = 4)	
	Mean	Std. Deviation	Mean	Std. Deviation
SiO_2	59.00	2.91	60.95	3.99
Al_2O_3	18.30	1.59	18.85	2.47
Fe_2O_3	2.24	1.07	1.89	0.73
FeO	0.70	0.56	0.69	0.28
MgO	0.84	1.10	0.61	0.41
CaO	2.44	1.48	1.81	0.71
Na_2O	7.49	1.33	7.50	0.84
K_2O	6.19	0.99	6.07	0.92
TiO_2	0.32	0.22	0.33	0.10
P_2O_5	0.16	0.17	0.12	0.07
MnO	0.07	0.04	0.06	0.01
CO_2	0.32	0.20	0.20	0.07
S	0.18	0.20	0.04	0.04
H_2O+	0.57	0.32	0.50	0.63
H_2O-	0.28	0.06	0.31	0.06
L.O.I.	0.00	0.00	0.00	0.00
TOTAL	99.08	0.49	99.90	0.72
Ag	<1.00	0.00	<1.00	0.00
Ba	826.19	477.19	615.00	254.89
Co	4.00	8.22	10.25	6.65
Cr	9.81	22.27	8.75	17.02
Cu	9.29	8.47	4.50	6.35
Li	25.52	25.28	15.00	9.13
Ni	6.67	18.33	2.00	8.12
Pb	41.19	22.58	42.50	21.02
Zn	60.95	30.40	67.50	35.94
Be	5.52	1.44	5.50	1.91
Mo	<1.00	0.00	<1.00	0.00
Sc	<3.14	4.70	<5.00	0.00
Sr	897.62	367.59	650.00	238.05
V	45.48	25.14	36.25	14.36
Y	18.81	27.56	11.25	14.36
Ga	17.62	2.56	17.50	2.89
Nb	<26.43	16.37	<30.00	0.00
Rb	174.76	32.19	145.00	36.97
Zr	246.19	198.33	337.50	249.58
Sn	<3.00	0.00	<3.00	0.00
Eu	<100.00	0.00	<100.00	0.00
Yb	<0.24	1.64	<1.00	0.00
La	<35.71	123.64	<37.50	125.00
Nd	<100.00	0.00	<100.00	0.00
Ce	181.43	104.66	202.50	49.92

TABLE A-5. CONTINUED.

	Unit 5n (N = 2)		Unit 5j,p (N = 15)	
	Mean	Std. Deviation	Mean	Std. Deviation
SiO_2	56.40	0.28	56.31	2.21
Al_2O_3	16.40	0.14	16.79	0.67
Fe_2O_3	2.08	0.15	3.15	0.88
FeO	4.07	0.47	3.14	0.80
MgO	4.11	0.43	3.42	0.68
CaO	5.26	0.23	4.99	1.04
Na_2O	5.18	0.62	5.42	0.47
K_2O	4.29	0.95	4.07	0.73
TiO_2	0.71	0.05	0.66	0.11
P_2O_5	0.43	0.05	0.42	0.12
MnO	0.12	0.01	0.12	0.02
CO_2	0.15	0.07	0.15	0.04
S	0.01	0.00	0.02	0.04
H_2O+	0.32	0.13	0.36	0.13
H_2O-	0.37	0.01	0.40	0.12
L.O.I.	0.00	0.00	0.00	0.00
TOTAL	99.90	0.14	99.43	0.39
Ag	<1.00	0.00	<1.00	0.00
Ba	990.00	212.13	1068.67	202.90
Co	17.50	3.54	16.73	8.07
Cr	147.50	31.82	75.00	42.76
Cu	35.00	0.00	32.67	21.62
Li	40.00	7.07	25.27	12.44
Ni	65.00	28.28	35.67	13.07
Pb	40.00	0.00	35.67	14.86
Zn	102.50	10.61	103.00	10.82
Be	6.00	0.00	5.40	1.12
Mo	<1.00	0.00	<1.00	0.00
Sc	15.00	0.00	11.87	3.14
Sr	850.00	212.13	993.33	298.73
V	125.00	35.36	111.33	31.14
Y	25.00	7.07	22.00	10.49
Ga	15.00	0.00	15.00	0.00
Nb	<30.00	0.00	<30.00	0.00
Rb	140.00	42.43	103.33	32.22
Zr	450.00	212.13	326.67	208.62
Sn	<3.00	0.00	<3.00	0.00
Eu	<100.00	0.00	<100.00	0.00
Yb	<1.00	0.00	<0.73	0.70
La	<100.00	0.00	<19.80	119.53
Nd	<100.00	0.00	<100.00	0.00
Ce	260.00	42.43	276.00	51.93

TABLE A-5. CONTINUED.

	Unit 6b (N = 11)		Unit 6d,g (N = 3)	
	Mean	Std. Deviation	Mean	Std. Deviation
SiO_2	57.04	3.54	61.57	3.91
Al_2O_3	18.99	0.99	17.67	0.55
Fe_2O_3	1.46	0.59	2.00	0.60
FeO	1.33	0.53	1.55	0.89
MgO	0.42	0.24	1.20	0.75
CaO	2.09	1.11	3.01	1.64
Na_2O	6.96	1.65	6.85	0.30
K_2O	7.34	0.92	4.16	1.80
TiO_2	0.37	0.12	0.50	0.17
P_2O_5	0.12	0.10	0.26	0.09
MnO	0.06	0.02	0.08	0.02
CO_2	1.42	0.96	0.31	0.10
S	0.21	0.19	0.03	0.01
H_2O+	0.84	0.40	0.25	0.06
H_2O-	0.29	0.05	0.25	0.03
L.O.I.	0.00	0.00	0.00	0.00
TOTAL	98.98	0.44	99.67	0.90
Ag	<1.00	0.00	<1.00	0.00
Ba	884.55	508.57	406.67	245.83
Co	6.27	1.01	10.67	4.04
Cr	<4.09	3.02	15.00	18.03
Cu	1.18	6.01	<1.33	6.35
Li	20.91	9.95	14.33	9.29
Ni	<5.00	0.00	10.00	15.00
Pb	11.82	12.30	25.00	15.00
Zn	55.91	20.35	83.33	28.87
Be	0.82	2.14	6.00	2.65
Mo	<1.00	0.00	<1.00	0.00
Sc	<5.00	0.00	2.33	6.43
Sr	895.45	249.45	500.00	264.58
V	30.45	12.34	41.67	23.63
Y	<5.91	9.17	20.00	10.00
Ga	16.36	3.23	20.00	0.00
Nb	<30.00	0.00	<30.00	0.00
Rb	190.91	46.79	93.33	61.10
Zr	125.45	117.14	480.00	468.72
Sn	<3.00	0.00	<3.00	0.00
Eu	<100.00	0.00	<100.00	0.00
Yb	<1.00	0.00	<0.33	1.15
La	<100.00	0.00	116.67	28.87
Nd	<100.00	0.00	<100.00	0.00
Ce	110.00	71.83	206.67	41.63

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